Draft Evaluation Report
MIDDLEFORD MILLS ARCHAEOLOGICAL DISTRICT
Bridge 238 On S 46, Over Gravelly Fork Sussex County, Delaware

By: Brian Crane, Dennis Knepper, Patrick O'Neill, Julie Abell-Horn

Delaware Department of Transportation Archaeology Series No. xxx

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Sussex County, Delaware

DelDOT Project xx-xx-xx DelDOT Archaeology Series No. xxx
FHWA Federal Aid Project xx

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CHAPTER 1: INTRODUCTION

The Delaware Department of Transportation (DelDOT) has replaced Bridge 238, on S 46 over Gravelly Fork, in Sussex County, Delaware. The bridge lies in an area referred to locally as the Middleford Mills, a milling and iron production complex that operated during the 18th and 19th centuries along the Nanticoke River. Phase I Cultural Resource Survey of the project right-of-way, completed in June of 1998, confirmed that S 46 follows an early 19th century mill dam, while Bridge 238 carries the road across what is believed to be a tail race or slipway. The survey found evidence of wooden structures of undetermined function in the waterway beneath the bridge, and indications of early ground surface deposits below fill layers associated with modern road and bridge construction. Excavation carried out underneath the bridge inside a cofferdam in 1999 exposed foundation remains from an earlier bridge and possible waste gate structure. Following the criteria set forth in 36 CFR 800.9(c) (1986 version), there was no adverse effect to the resources identified underneath Bridge 238 because the information value has been collected via data recovery. The following documentation is intended to fulfill the requirements of 36 CFR 800.8(a) (1986 version).

DESCRIPTION OF THE UNDERTAKING

DelDOT replaced Bridge 238, in Sussex County with a wider, concrete structure. The improvements consisted of removing the existing Bridge 238 structure, building a precast concrete culvert on a cast-in-place concrete pile foundation, installing drainage and guardrail, and reconstructing roadway approaches with bitumous concrete. Plans for the new bridge and road are shown in Figure 1. The general location of the project is shown in Figure 2.

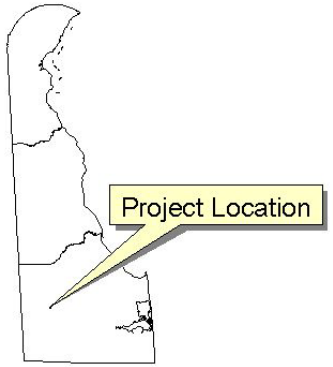
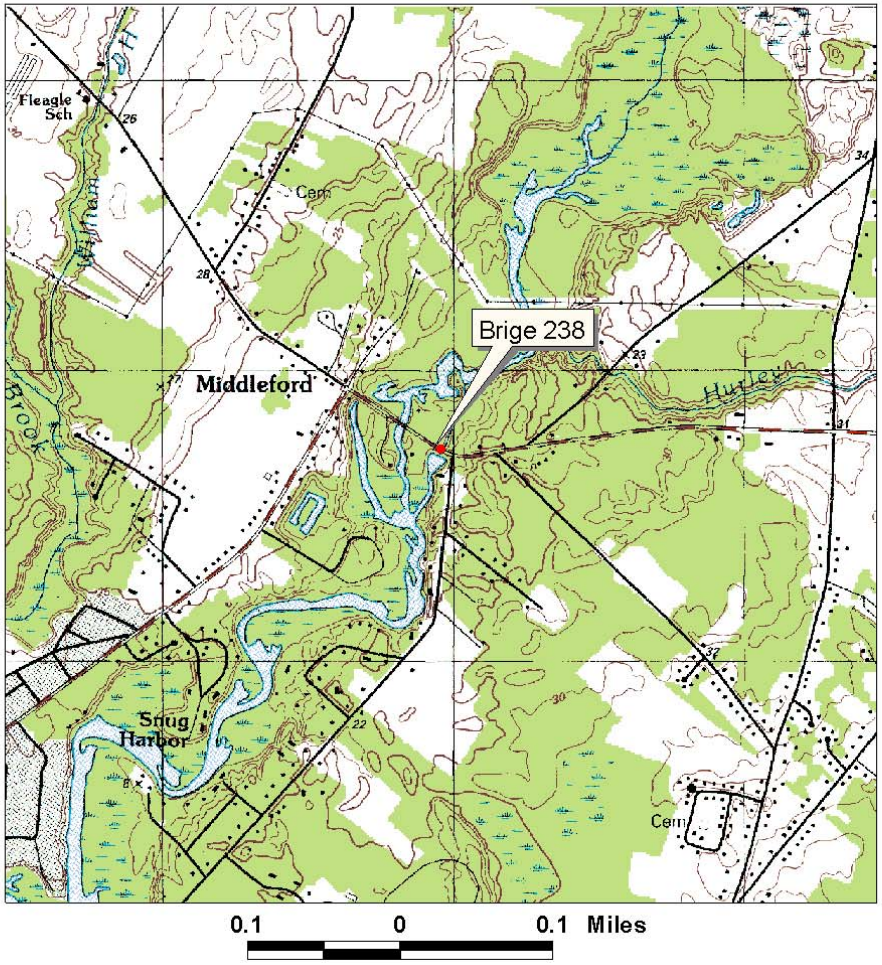


Figure 1: Plans for Bridge 238 on S 46



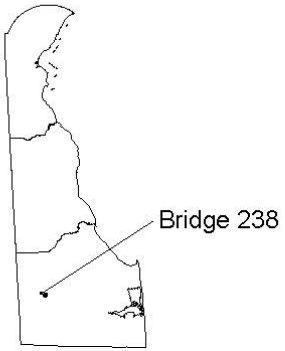
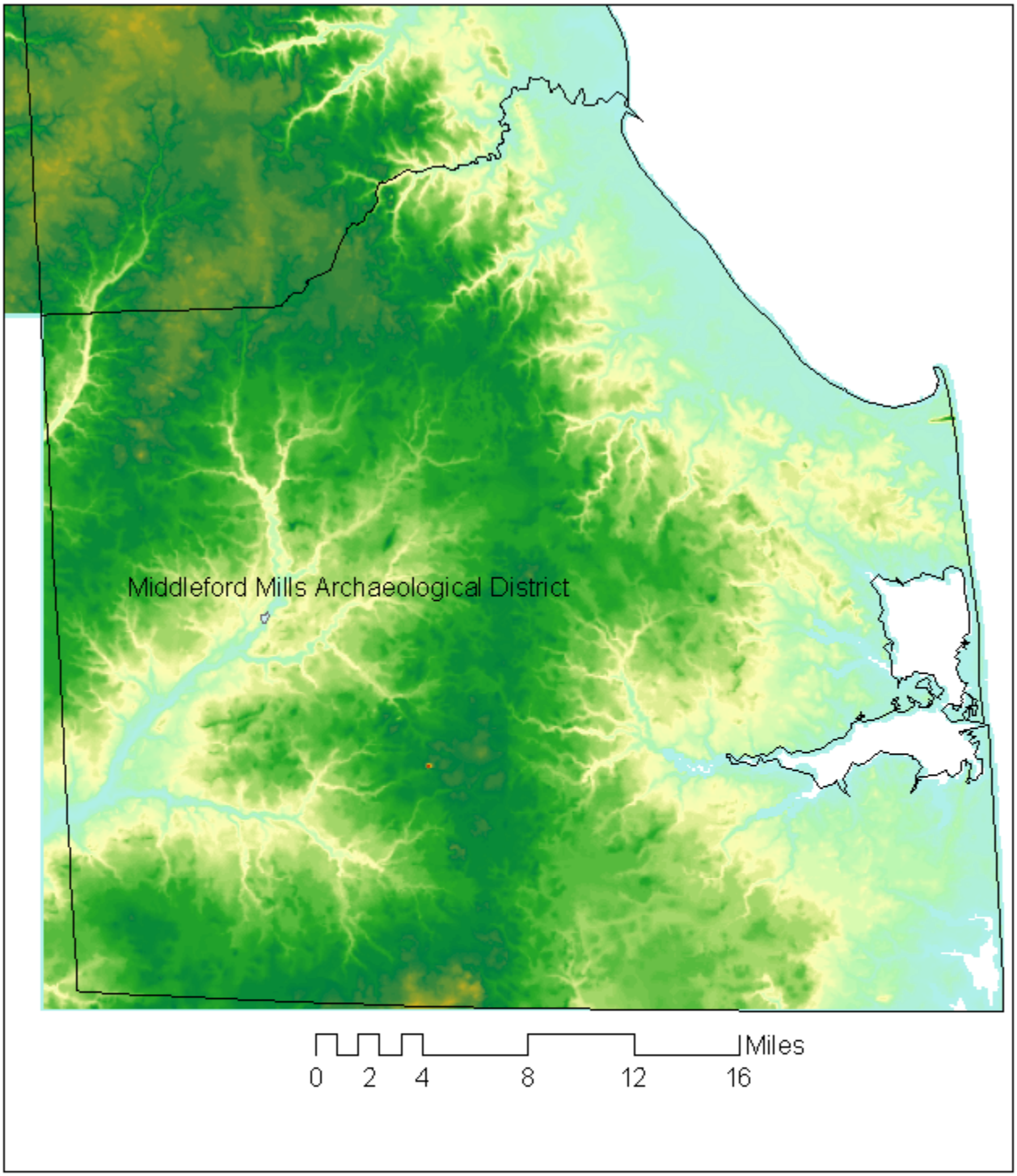


Figure 2: Bridge 238
Project Location



Legend

Value

High : 495.000000

Low : 1.000000

Figure 3: Middleford Mills Location on Sussex County Elevation Model

CHAPTER 2: HISTORICAL BACKGROUND

ENVIRONMENT

The project area is located in Sussex County, within the Nanticoke River Watershed (Figure 3). The Nanticoke River flows into Maryland, and then the Chesapeake Bay. The Nanticoke River is tidal at Middleford. The soils in the streambed surrounding Bridge 238 are Johnston Silt Loam, which "consists of very deep, very poorly drained, nearly level soils on flood plains in the Coastal Plain" (USDA 2002). Other soils in the archaeological district include Evesboro loamy sand and Evesboro sand. The dominant vegetation in wooded areas in the vicinity is "black oak, white oak, and chestnut oak with scattered hickories, pitch pine, Virginia Pine and scrub and blackjack oaks" (USDA 1999). During the course of field investigations, bog iron was observed in the streambed. The immediate vicinity of the bridge today is characterized by wooded areas and suburban housing developments.

SUSSEX COUNTY HISTORY

Henry Hudson discovered the Delaware Bay in 1609. The earliest European occupation in the Sussex County area, however, did not begin until 1659, when Dutch immigrants settled at or near present-day Lewes in a settlement called Hoerenkil (Doherty 1997:3; Harbeson 1992:17; Scharf 1888:1221). Swedish immigrants had established Fort Christina on the Upper Peninsula to the north in 1638, and the Dutch had already established a settlement at Fort Casimir, on the Delaware River near modern-day New Castle, to block a Swedish advance to the south (De Cunzo and Catts 1990:9). A Dutch military presence forced the Swedes to relinquish power to them in 1655, although the Swedish and Finnish settlers remained.

The Dutch were soon inundated by English settlers, and tension between the two factions flared for many years, until Holland ceded many of its possessions extending from New York to Delaware to the English in 1676 (Harbeson 1992:17). The region was then placed under the jurisdiction of the Duke of York, with the top seat of government in New York. In 1670, Lord Charles Calvert I, third baron of Baltimore, created Durham County encompassing much of present-day Delaware and Maryland, including the present study region (Doherty 1997:51; Demars and Richards 1980:4-5). To help stop Lord Baltimore from claiming regions of Delaware, the Duke of York granted a large tract of the Delmarva peninsula to William Penn in 1682. Dispute over control of Delaware between what would become Pennsylvania and Maryland clouded the regional land patents for many years, and as a result, the south and west portions of Delaware were granted many Maryland patents (Figure 4; Russ 1966:12-13).

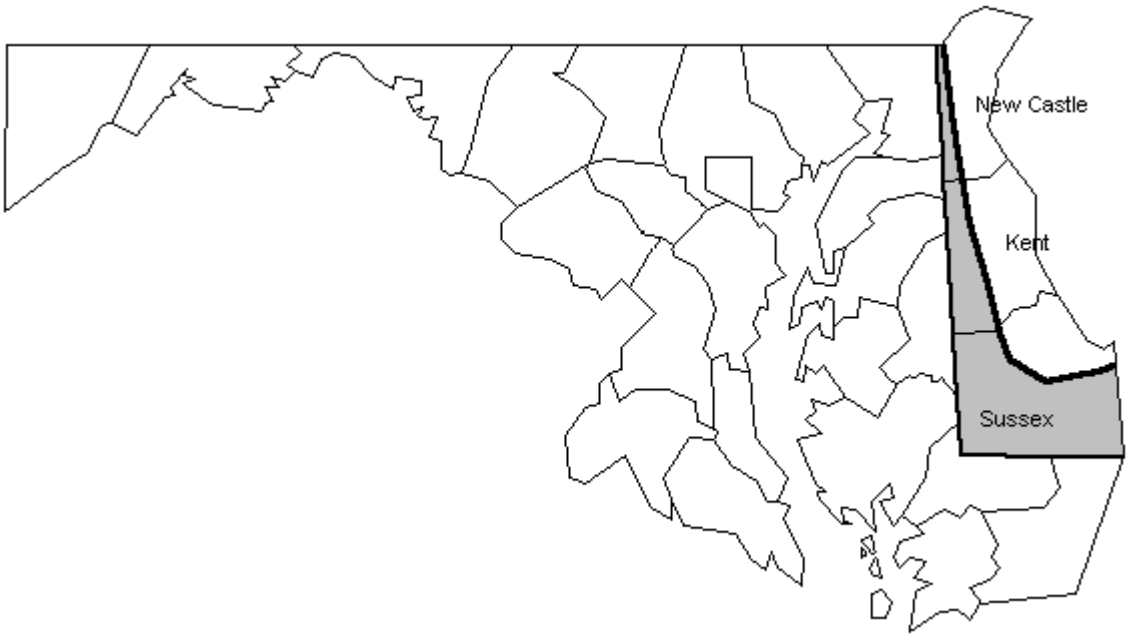


Figure 4: Lord Baltimore granted several patents to colonists in western Delaware (shown in grey).

In 1682, Penn was given control of the distribution of the tracts, which he referred to as the lower three counties of Pennsylvania (Doherty 1997:3). The region was divided into townships that would contain 100 families, each of which contained approximately ten members. The townships were referred to as "hundreds" and these political designations have remained intact to modern times. Middleford was located in Northwest Fork Hundred, established in 1775, and in 1869, Seaford Hundred was created out of the southern half of Northwest Fork Hundred (Doherty 1997:5).

Lord Baltimore continued to file land patents in the area, creating much confusion and resentment in Pennsylvania. Baltimore's grants were contested by Pennsylvania well into the 18th century, by which time Baltimore's son lost the claims (Demars and Richards 1980:4). The land grants issued in the Delaware prior to the 1750s, were mainly the result of the influx of the Swedish and English immigrants in the upper Delaware and Philadelphia, Pennsylvania region. The Sussex County land remained largely unpopulated except on the coastal regions (De Cunzo and Catts 1990:11-12).

Most of the residents of Sussex County in the 1700s were farmers, growing corn, rye, wheat, and tobacco as principal crops. Gristmills were some of the earliest industries in the area, and many became the hub of small hamlets or towns (O'Connor et al. 1985:13-14). The farms were successful, but were mainly subsistence oriented. They remained as such even though their counterparts in Kent and New Castle counties were able to shift to a market-based economy by the middle of the 18th century. The grist and

flour mills of Brandywine Hundred, in particular, helped to bring financial growth to northern Kent and southern New Castle counties in the mid-1700s (Welsh 1973:79).

Deposits of limonite, or bog iron, were discovered in Sussex County in the mid-1700s, and soon iron ore processing sites were established across the region, including the Unity Forge near Concord, Collins Forge on Gravelly Branch, and Deep Creek Iron Works, northwest of Georgetown at Concord (Harbeson 1992:18-19; Heite 1974:18). The forges required an immense amount of fuel, and since coal was not locally available, the primary forests were harvested to produce charcoal (Passmore 1978:14). Mine owners either purchased thousands of acres outright or acquired the rights to work the land solely for the harvest of the timber. Blast furnaces for processing the ore were scattered across Delaware, the last one closing in 1836 (Passmore 1978:14). The need for charcoal, coupled with the need of lumber for ship and building construction, contributed to the rise in the number of sawmills in southwest Delaware.

Iron producing communities were many times characterized by the presence of a centralized furnace with peripheral farming, lumber, and charcoal related industries (De Cunzo and Catts 1990:13). In contrast to the hilly, northern piedmont, the flat, coastal regions of Sussex County demanded wide and substantial mill pond dams to create enough of a water head to operate the grist and sawmills, as well as the forges. In northern Kent County and all of New Castle County, mill pond dams were usually narrower than those in Sussex County because the watersheds were deeper and more constricted. As a result, more capital was needed to establish these industries in Sussex County, and many small communities that developed around the larger mill ponds contained all three industries. An analysis of the 1868 Beers Atlas indicates many of the grist and sawmills were located together, usually on the larger mill ponds.

Ships were constructed along the Nanticoke River as early as 1700, and were used for imports of all goods and to export the processed iron, charcoal, and lumber (Passmore 1978:11 and 64; De Cunzo and Catts 1990:10). After the Revolution, lumber continued as an important export for the region, and the fishing and oyster industry started to rise, increasing the need for more ships of all sizes and shapes; thus further supporting the lumber industry.

Deforestation and related soil erosion became one of the downsides of this economic growth. As the lumber and charcoal industry grew, the primary forests were harvested, and land was cleared and turned for cultivation. Trees were also harvested to uncover areas for mining bog iron. Clearing the forests led to the erosion of the unstable and unprotected topsoils, a widespread problem in colonial America (Cronon 1983). Such erosion could have resulted in the siltation of mill ponds and waterways of Delaware.

A second major problem affecting Sussex County's economic growth was the lack of roads despite the region's growing prosperity (Figure 5). Farmers and merchants in western Sussex County had to rely primarily on water transportation for exports and imports (Harbeson 1992:18). A wharf has been located on the Nanticoke River just down

stream from the Middleford mills, indicating water traffic extended at least to that extent up that particular river. Yet the Kings Road, now Route 13, which was the main artery from north to south Delaware, did not extend to the southwestern portions of the state. Until Maryland and Pennsylvania settled the Delaware boundary disputes in the mid-18th century, Southern Delaware continued to lack a market-based economy, as compared to the rest of the State (De Cunzo and Catts 1990:10).

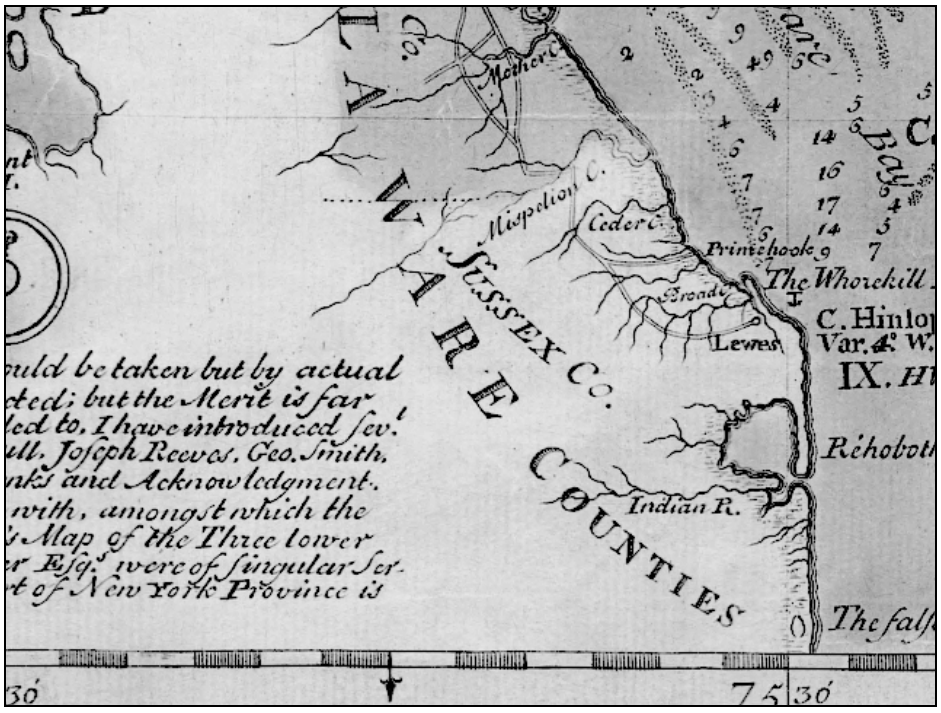


Figure 5. 1749 map illustrating the lack of roads in the southwestern part of the state.

The lack of transportation infrastructure and local markets impeded commercial and social development. Without roads, goods could not be taken to market. Without market access, goods could not be brought into the region, nor would immigrants be encouraged to populate the area. Without the exports or imports, the region was severely stifled. Sussex County continued to lag behind the rest of the State in economic development throughout much of the 1800s.

After Delaware settled the land dispute with Pennsylvania in 1770, Sussex County was formed and was as large in surface area as New Castle and Kent counties combined (De Cunzo and Catts 1990:16-17). Since Sussex County was the southernmost county of Delaware, it was also the furthest away from the larger markets and cities of New Jersey, Maryland, and Pennsylvania.

The lack of economic development also helped fuel "isolationism" that was greatly enhanced during the American Revolution. Over the next 100 years, Sussex County had a higher percentage of slaves than the upper two counties of the State, partly because of the greater prevalence of Tobacco cultivation there. As a result, Sussex County was torn during the civil war by the presence of both Union and Confederate sympathies throughout the region.

Sussex County is composed entirely of a coastal plain, whose sandy soils quickly lost their nutrients. Farmers learned in the early 1700s to rotate crops. Tobacco was grown on freshly cleared ground, while grains, such as wheat, corn, and rye, were grown mainly on previously tilled ground (Passmore 1978:22). However, farming practices in Delaware had still quickly leached the sandy soils of the major nutrients and led to the almost complete destruction of the topsoils by the 1830s (Passmore 1978:16). James C. Booth's 1841 book entitled, "*Geological Survey of Delaware*" provided wonderful insight to the Delaware farmers to reconstitute their soils, and he is praised with saving agriculture in the region. He encouraged farmers to add oyster shell and marl to their fields. Booth praised central Sussex County as containing some of the more fertile soils of Delaware (Passmore 1978:19).

The coming of the railroad industry in the 1850s enabled the non-coastal central regions of Delaware to be settled (Figure 6; Passmore 1978:7). The smaller towns in rural central Delaware were then able to send their goods directly to interstate markets by train rather than by wagon and carts via the nearby seaports, such as Seaford and Milford. The railroad allowed all industries to expand at a fast growth rate (Harbeson 1992:21). Yet by 1924, there still were only 15 miles of paved roads in the county (Passmore 1978:8).

Corn was the main agricultural crop in Sussex County during the colonial period, but was replaced by the fruit industry during the last half of the 19th century (Passmore 1978:24). The center for the peach industry was primarily in New Castle County, Kent County was known for apples, and the berry industry became popular in Sussex County. Sussex County grew more strawberries in 1902 than any other county in the country (Passmore 1978:72-73). By World War II, even the berry business gave way to the new and fast-growing broiler chicken industry.

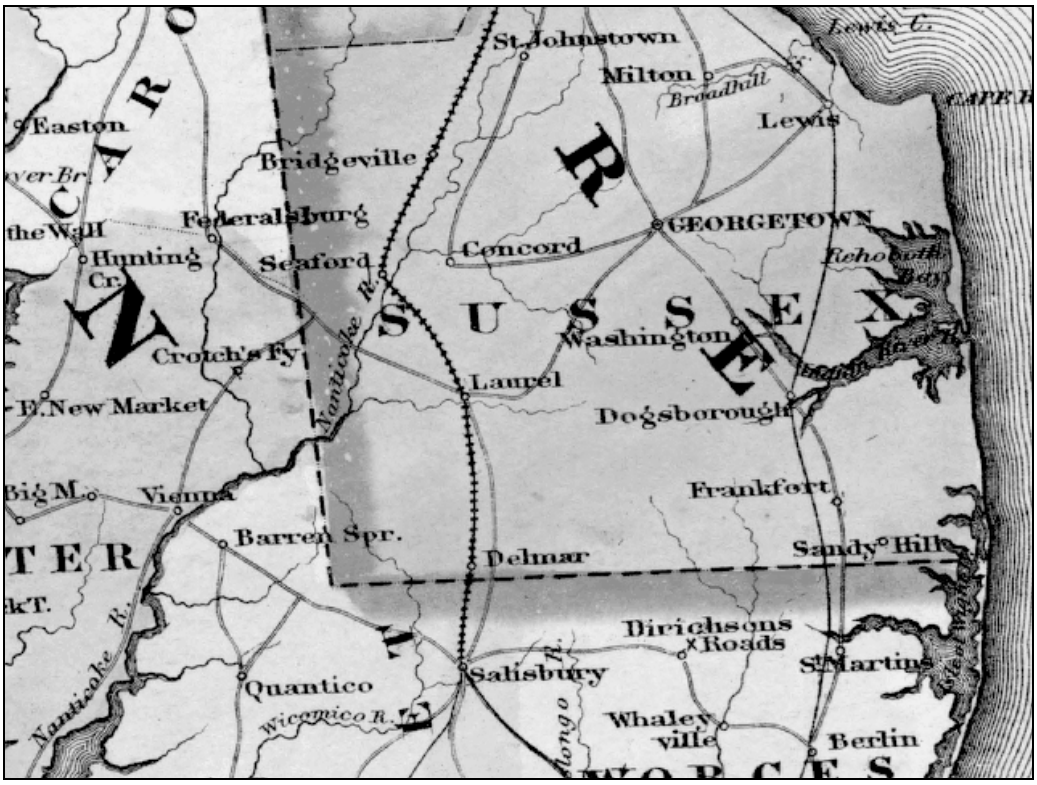


Figure 6. 1862 map showing the railroads and roads of southern Delaware.

The 1920s and 1930s saw the development of the famous Delmarva broiler chicken industry. Since 1934, chickens have represented over half of the farm income for Delaware farmers (Passmore 1978:58). The success of the chicken industry has been credited for helping the local farmers to weather the Great Depression. The Soil Conservation Service established districts in Sussex County in 1944, and most farmers then had farm plans on file with the district, greatly enhancing their yields, making Delaware known as one of the agricultural centers of the central Atlantic seaboard (Passmore 1978:108).

SITE HISTORY

The history of the Middleford Mills Archaeological District begins in the 1760s, when the initial documented development of the area occurred. Nanticoke Hundred's first iron works company to incorporate was the Deep Creek Iron Works, headed by proprietor and iron master Jonathan Vaughan of Chester County, Pennsylvania. Otherwise known as "Vaughan and Company," the group, which included iron masters William Douglas and John Chamberlain, as well as Philadelphia merchants Persifer Frazer, Christopher Marshall and Daniel McMurtree, acquired large tracts of land on Deep Creek and the Nanticoke River. At Deep Creek, they built a furnace, called "Deep Creek Furnace," and later referred to as "The Old Furnace." Along the Nanticoke River at the head of the tide water, four miles east of Deep Creek, the company purchased three tracts of land, called "Venture," "Company Lot," and "Brother's Agreement" in 1764.

Venture and Company Lot were on the west side of the river, within and north of what would later become the 19th-century town of Middleford in Northwest Fork Hundred. Brother's Agreement was on the east side of the river, in Nanticoke Hundred. Company Lot overlapped with portions of the two other tracts (Figure 7). The company constructed a dam across the river oriented north northwest by south southeast, and along the portion of the dam included in the Brother's Agreement property, they built the "Nanticoke Forge" (Scharf 1888).

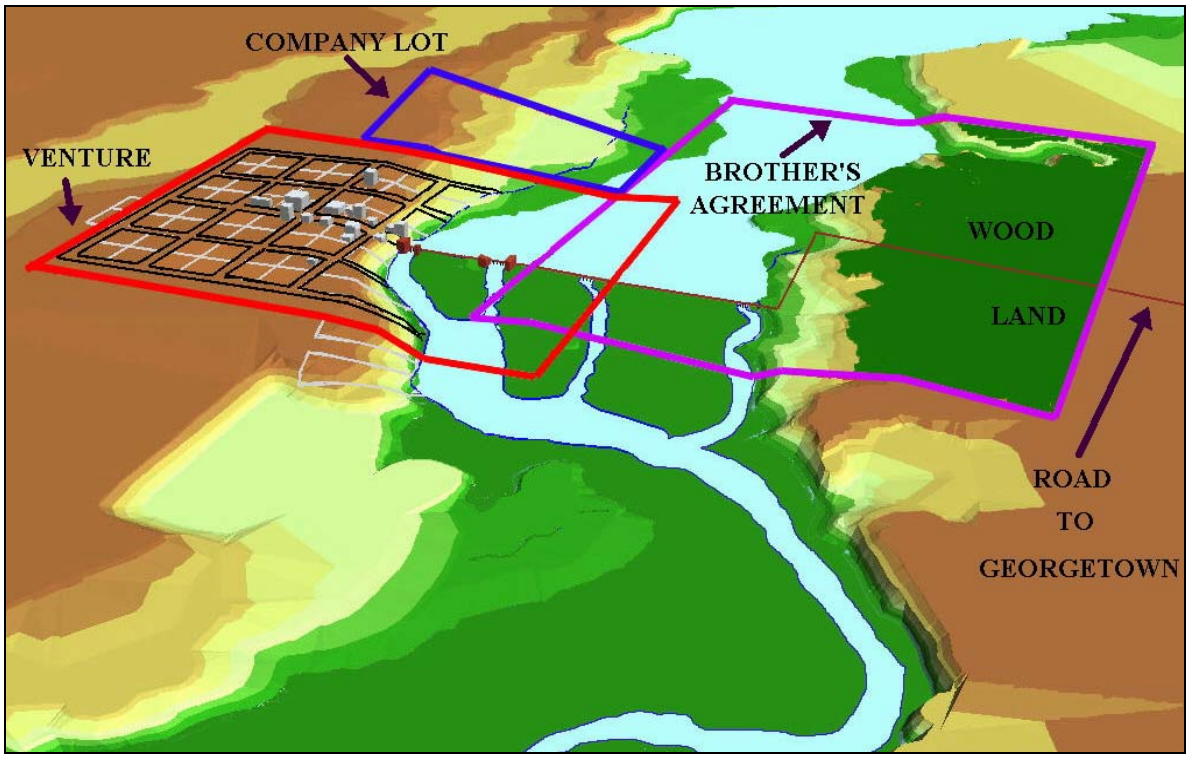


Figure 7: Birdseye view of the three tracts purchased by the Huffington Brothers and Townsend in 1805 as viewed circa 1831. The "Venture" tract became Middleford.

The location along the Nanticoke River was attractive to the iron company for several reasons. Much of Nanticoke Hundred contained sizeable bog iron deposits, which could be mined, then heated in a bloomery forge or bog ore furnace to produce iron. The bog iron was found in shallow pockets along local stream banks (Heite 1974). The area around what would become Middleford was no exception. Forges required both water power to operate their bellows, and a large supply of charcoal to feed their fires. This particular section of the Nanticoke river, being at or near the head of the tide water and having a wide, relatively flat bed and bank, was in an ideal location to construct a dam and mill pond that could produce the water power needed both for the forge, and for additional milling operations necessary for the upkeep of the facility and its workers, such as a sawmill and a gristmill (Tunnell 1954). The land surrounding the river was rich in timber, which could be harvested to provide the charcoal needed for the fires. Last,

the river itself could serve as a transportation route to move the finished products downstream to markets along the eastern seaboard and England via the Chesapeake Bay.

Vaughan and Company purchased large tracts of woodland within the vicinity of their furnace and forge sites, as well as in other parts of Sussex County. When the company reorganized in May 1764, admitting additional members William Wishart and Jemima Edwards, the new articles of agreement indicated they had acquired about 7,000 acres of land in total. At least 5,000 of these acres were located between the furnace and the forge sites. By 1770, the Nanticoke River location contained the forge, a gristmill, a sawmill, and a company store. While the forge was located within the Brother's Agreement property, which encompassed the eastern side of the river and part of the mill pond, the grist and sawmills appear to have been situated closer to the west side of the river, probably along the portion of the dam that fell within the Company Lot boundaries (Scharf 1888; Hancock 1976; Purvis n.d.). Three mill races (presumably one each for the forge, gristmill and sawmill) coursed downstream from the dam (Purvis n.d.).

The earliest surviving map of the Middleford Mills area is from 1807, the result of a Court of Common Pleas case involving another mill upstream (Figure 8; Kent County Warrants and Surveys B9 #177). The court case text has not survived, but its extant accompanying map clearly shows the three land tracts surrounding the river, and the 18th-century mill dam, now unused. Although the locations of the forge and associated mills are not illustrated, since the structures had been razed prior to this time, it is likely that all were situated along this original dam, with the forge located furthest to the east.

Like other iron works in Sussex County, the Nanticoke Forge endured until early in the Revolutionary War, when the British blockade of the Chesapeake Bay forced the companies out of business because they could not get their goods to market (Tunnell 1954). Jonathan Vaughan became a lieutenant colonel in the Continental Army, Persifer Frazer reached the rank of general, and many of the men formerly employed in the iron making business joined the call for troops. Although the blockade forced the forges and furnaces to close down, the saw and gristmills associated with the iron works continued to operate for local business during this period (Scharf 1888, Heite 1974).

Even though it did not resume operations after the war, the Deep Creek Iron Works still existed, at least in name, through the 1790s. Tax records from 1796 indicate the organization then was called Marshall, Wishart, Pennell & Company. However, because so many people had become involved in the partnership (most of the original proprietors had died, leaving multiple heirs), business could not be conducted and the lands and improvements could not be partitioned. Finally, after two petitions to the State Legislature by heir Levi Hollingsworth in 1801 and 1802, the state passed an act in January 1802 to partition the lands of Deep Creek Furnace, Nanticoke Forge, and lands purchased for their use (Heite 1974). The tract of land including the Nanticoke Forge area went to the heirs of Joseph Pennell (Scharf 1888, Sussex County Deed Book AB 25:114-117).

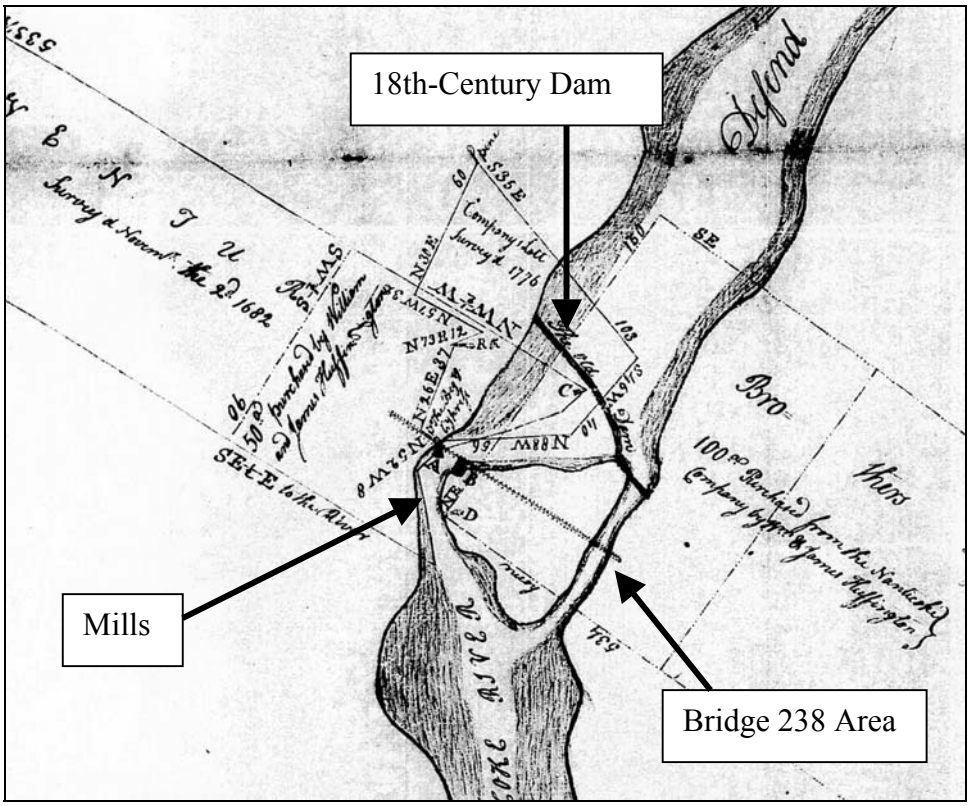


Figure 8: Earliest draft of Middleford soon after its establishment in 1807 (Kent County Warrants and Surveys B9 #177).

The first years of the 19th century marked the beginning of the second phase of development at Middleford. Brothers William Huffington, Jr., and James Huffington, and their partner Thomas Townsend purchased the Nanticoke Forge property, described as 168 ½ acres of land including parts of Brother's Agreement, Venture, and Company Lot, from the heirs of Joseph Pennell in January 1805 (Sussex County Deed Book AB 25:114-117). That same month, the trio filed articles of agreement to name the village of Middleford, and form the Middleford Company, which the new milling operations henceforth would be called (Sussex County Deed Book Z24:338-339). In 1806, the company purchased 400 acres of Brother's Agreement from John and Sarah Adams and William and Margaret Adams (Sussex County Deed Book AB 25:525-526).

When the Nanticoke Forge tract changed hands in 1805, the 1760s forge was no longer standing, although the ruins were clearly visible on the ground surface, according to a court case lodged in 1826 in which deponents were asked about the property (Sussex County Chancery Case H81, Edward Huffington et al. vs. Sally Adams et al. 1826, hereafter referred to as Huffington vs. Adams 1826). This court case, which forms the basis for much of the information known about the Middleford Mills during the 1800s-1820s, concerned the ownership, and former and current use of the Brother's Agreement tract, and included details about the Nanticoke Forge and the Middleford Mills. According to the recollections of local resident W.W. Purvis (n.d.), the forge site lay within the property of 20th-century owner Louis King (who owned Nanticoke Hundred

parcels 81 and 82, north of S 46 during the 1950s). This siting would be consistent with the location of the eastern end of the 18th-century dam, and the Brother's Agreement tract. Although there is no mention of the associated 18th-century mill structures in the court case, it is probable that they, too, had been abandoned some time prior to the land sale, were no longer functioning, and possibly had been razed as well.

The first construction project the Middleford Company undertook in 1805 was a new dam, located ca. 300 yards downstream from the 18th-century dam. The top of this dam now carries S 46. Next, along the northwestern end of the dam, the company constructed a sawmill and set of waste gates, just outside of the Brother's Agreement boundary. Within a year, the company had erected a gristmill just northwest of the sawmill (Huffington vs. Adams 1826). As shown on the 1807 map of the property, the two mills shared a single mill race, or waste gate. The map shows another mill race, or waste gate, at the extreme southeastern side of the mill pond, at or near the present location of Bridge 238. This mill race may represent a reused former mill race channel from the 18th-century dam further upstream. Between 1807, when the map was made, and 1814, when William Huffington, Jr., died, Huffington constructed a third mill race and set of waste gates between the sawmill and the southeasternmost mill race and waste gate. Deponents in the 1826 court case all explicitly described two sets of waste gates on Brother's Agreement, erected by Huffington in his life time (Huffington vs. Adams 1826).

In addition to the mills, Huffington also built a new forge within the boundaries of Brother's Agreement, although its location is unclear. Since forges typically used water to operate the bellows, this forge likely would have been situated on the dam, or along one of the tail races. Historical records indicate that the forge did use charcoal to fuel its fires, and Huffington cut wood from portions of Brother's Agreement over the course of several years to meet these requirements. The logs, primarily pine, were coaled (turned into charcoal) right on the ground where they had been felled. Soon after they purchased it, William and James Huffington had cleared at least one field within the tract on which to plant corn; the trees from this field were coaled and used in the forge. The wood needed to build the forge itself also came from trees on this property. Some deponents in the 1826 court case believed that Huffington had harvested additional wood from Brother's Agreement and sold the timber, principally oak, in the Baltimore markets (Huffington vs. Adams 1826).

At the time of his death in 1814, William Huffington, Jr., was the sole owner of the Middleford Company. Thomas Townsend had sold his interest in August 1805, and James Huffington had relinquished his share in 1807 (Sussex County Deed Book AB 25:117-118, 525-526; Huffington vs. Adams 1826). Because Huffington died intestate, his estate was administered by the county Orphans Court (Sussex County Orphans Court Case Files 1815). Complicating matters was the fact that after Huffington died, neighboring landowner Jesse Green instituted an "ejection suit" against Huffington's heirs, claiming that the land constituting Brother's Agreement had been sold to the Huffingtons under a false title. The land in question had been addressed in several Court of Common Pleas court cases during the 1810s, during which William Huffington, Jr.,

and Jesse Green had battled over ownership (the court cases are addressed in Huffington vs. Adams 1826). The courts had ruled in favor of Huffington, but at his death, Green again attempted to regain the land, and this time he won. Ultimately, the Huffington heirs had to relinquish 300 of the 400 acres of Brother's Agreement to Green (Huffington vs. Adams 1826).

The 100 acres of Brother's Agreement including the mill tract remained in the possession of Huffington's sons, William and Edward Huffington, after his death in 1814. In 1817, Edward released his share of the property to William (Sussex County Deed Book AK 33:326). However, a separate Court of Common Pleas suit against the heirs, in 1823, made by George and Jacob Lindenburger and Jacob Walter, of Baltimore, found in favor of the plaintiffs, and Sussex County sheriff, Levin Stuart, had to seize the mill property and sell it at public auction to cover the incurred debts and damages (addressed in Huffington vs. Adams 1826). Mitchell Huffington, the younger brother of William and Edward Huffington, purchased the mill property (now comprising 170 acres) at the 1823 sheriff's sale, and immediately sold the tract back to former Middleford Company partner, Thomas Townsend (Sussex County Deed Book AM 35:564-565; Huffington vs. Adams 1826).

It appears that the mills at Middleford continued to operate after William Huffington, Jr.'s, death, although the forge seems to have closed soon after he died. Deponents in the 1826 court case indicated that Huffington's sons did not continue to operate the forge much longer after their father's death. In 1826, the 100 acres of Brother's Agreement contained the aforementioned two sets of waste gates on the mill dam, several small frame tenant houses, and a few peach trees. Most of the remaining timber on the 100 acres had been harvested by Huffington (Huffington vs. Adams 1826).

At the time that William Huffington, Jr., died, local residents believed that he was insolvent, and that the mill property and its profits could not cover his debts (Huffington vs. Adams 1826). Perhaps as a reaction to Huffington's economic situation, shortly after Thomas Townsend took over the mills he rebuilt the complex to achieve greater production and profits. At the time, Townsend also owned a grist and sawmill complex in Little Creek Hundred, called "Big Mills," located about one mile below Laurel, which his father had built before 1800 (Sussex County Orphans Court Case Files; Purvis n.d.). By 1825, Townsend had found a way to kiln-dry cornmeal for shipment to distant markets. His invention allowed him to export large quantities of local crops, particularly to the West Indies, which resulted in substantial profits. In order to accommodate the shipments, Townsend employed eight coopers to make puncheons and barrels. The products were loaded on ships directly from the mill, and sent down river (Scharf 1888; Purvis n.d.).

Thomas Townsend died intestate in 1827, forcing the county Orphans Court to administer his estate. By 1832, his oldest son, local merchant, Barkley Townsend, became heir to most of the property, having settled accounts with his siblings, all of whom were underage at the time of their father's death. Townsend inherited two-thirds of the estate, while his mother, Mary, who later married Alexander Campbell, received

the customary one-third part widow's dower (Sussex County Orphans Court Case Files 1831-1832).

In 1831, as part of the Orphans Court proceedings, Barkley Townsend commissioned a survey of the Middleford Mills complex and adjacent lands. Figure 9 shows the extent of the area's development since its last depiction in 1807. Most notably, the town of Middleford is illustrated to the northwest of the mill dam, and the mill pond appears with four mill races or waste gates. Separate races are shown for the gristmill and the sawmill (unlike the 1807 map, where they appear on opposite sides of the same race), and two waste gate races appear to the southeast of the mill races, within the Brother's Agreement property. The land slated for the widow's dower appears north of the town grid.

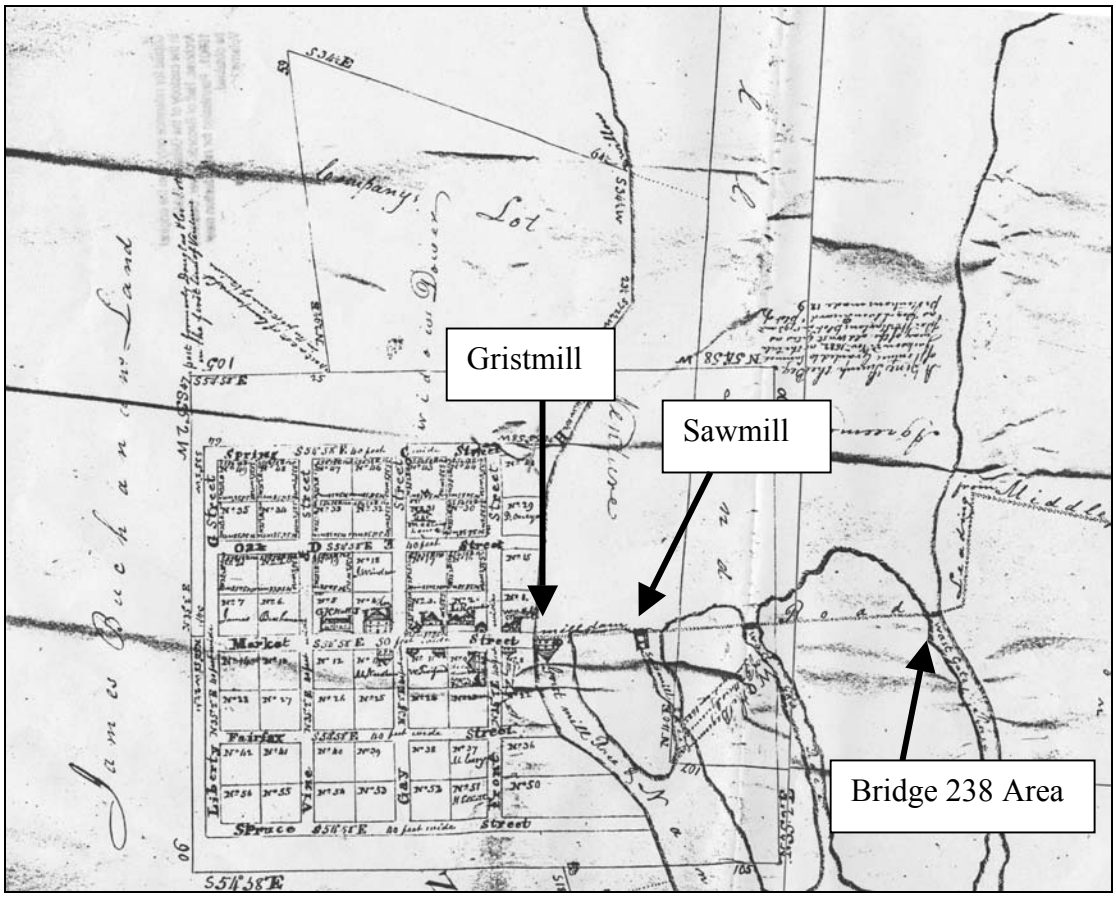


Figure 9: The 1831 plat of Middleford showing town lots and the mills.

Barkley Townsend was only in his twenties when he inherited the Middleford Mills complex. To pay his siblings for their share of the estate, and in order to keep the mills running, he had to raise a substantial amount of capital. He approached local businessmen James Buchanan and Levin Stuart to back the venture, but they agreed only after Townsend resolved to sell half the interest in the mills to another party. They felt

that Townsend was too young and the property was too large for him to manage himself. Townsend and his wife sold half the interest in the mills to Robert Houston in April 1832, although the deed officially was not recorded until 1836, after a chancery court suit between Houston and the heirs of Thomas Townsend involving the mills' ownership (Sussex County Chancery Case File H67, Robert Houston et al. vs. Lewis West et al 1840-47, hereafter referred to as Houston vs. West 1840-47; Sussex County Deed Book 45:380-384).

The Houston vs. West 1840-47 chancery court case forms the basis for much of the information known about the Middleford Mills in the 1830s and 1840s. According to one deponent in the case, Barkley Townsend chose to sell half his interest to Robert Houston because Townsend thought Houston would be a good partner, despite the fact that another buyer might have offered more money. Houston paid Townsend $600, part of which included half interest in a "vessel" (presumably a sailing vessel) owned by Houston (Houston vs. West 1840-47).

The sale to Houston was well known within the local community, although some were unhappy with the transaction. In particular, William and Michael Stuart, who had rented the Middleford sawmill from Townsend in the past, were looking to acquire an interest in the property (Houston vs. West 1840-47). William already owned a store house and counting house in Middleford and a tract called "Vaulti," south of Brother's Agreement along the old forge race, both purchased from Thomas and Mary Townsend in 1825. In addition, he owned the "Big Mills" complex in Little Creek Hundred, which Barkley Townsend sold as his father's heir in 1829 (Sussex County Deed Book AO 37:205-206, 206-207; Sussex County Orphans Court Case Files 1831-32). Michael owned and operated a store in Middleford at the time as well, and Barkley Townsend owed him money. The two men's wives were sisters (Houston vs. West 1840-47).

Eventually, in August 1832, Barkley Townsend capitulated and sold his remaining half of the mill property to William and Michael Stuart (Sussex County Deed Book 43:313-314). For the rest of the 1830s and into the 1840s, the Stuarts and Houston owned the mills and associated real estate as "tenants in common" (Sussex County Chancery Court, Volume C, pp. 87-98).

Several important events occurred in the mid-1840s that would affect the Middleford Mills significantly. In 1845, Robert Houston sold his half of the mill property (excepting a small lot leased to William and Michael Stuart for a cooper shop) to Lot Rawlins, a successful local merchant and businessman who was already beginning to acquire property in and around Middleford (Sussex County Deed Book 52:238). Rawlins and his sons would run the mill complex for the next 50 years. In 1846, the gristmill caught fire and became inoperable for over a decade (Scharf 1888:1304-1305). Robert Houston had insured the gristmill against fire with the Delaware Fire Insurance Company while he owned the property, but Lot Rawlins had to sue the insurance company in Sussex County Superior Court in order to collect the damages. The money was not awarded until 1849, and in 1852, tax records indicate the gristmill still had not been rebuilt (Sussex County Case Files 1858).

The same year the gristmill burned, William and Michael Stuart petitioned the Sussex County Chancery Court to divide the mill property among the current owners. The court ordered a survey made, which survives but is severely torn and damaged (Figure 10). The portions of the map that are legible show the gristmill as burned, both waste gates in operation, a "small house now occupied as a cooper's shop" between the two waste gates and north of the dam, and a "small house formerly occupied by Betsy O'Day" on the east bank of the mill pond. The land south of Brother's Agreement, including part of the waste gate run, was owned by William Stuart. The court ruled that the mill property should not be physically divided, but rather each owner should be given a share in the operation. The court gave William and Michael Stuart each ¼ interest, and Lot Rawlins ½ interest in the mills and property. The Stuarts each were entitled to use the mills one week in four, and Rawlins two weeks in four. Various Middleford town lots, also part of the mill property, were assigned to each man (Sussex County Chancery Court, Volume C, pp. 87-98, William and Michael Stuart vs. Lot Rawlins 1846).

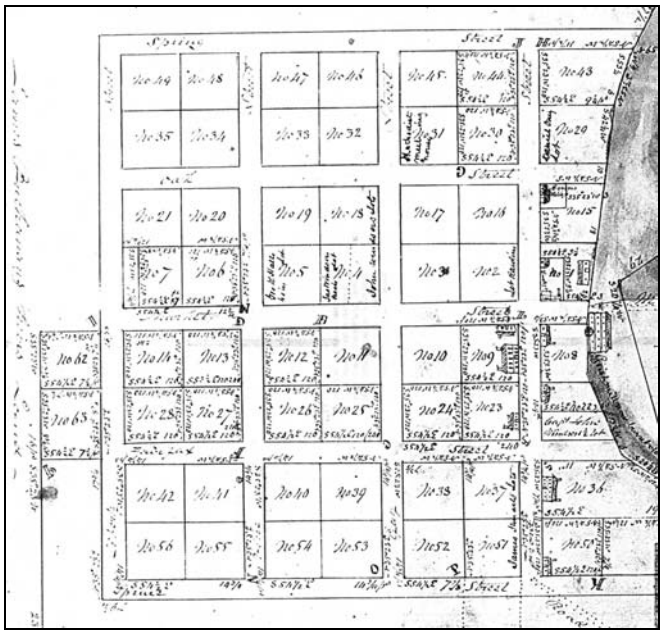


Figure 10: Middleford in 1846.

William and Michael Stuart did not utilize their shares of the mill property beyond the 1840s. In 1848, William died, leaving his son James (Michael's brother) as executor of his estate and chief heir (Sussex County Orphans Court Case Files 1848-49). By 1849, Michael had relocated to Baltimore, leaving James to control his share of the mills as well (Sussex County Probates). Michael died in 1850, and although his interest in the mills passed to his six children, by 1855 only two of the children were still living, both girls under 21 (Sussex County Orphans Court Case Files 1850; Sussex County Probates). Their uncle James Stuart petitioned to administer Michael's estate that year,

thereby acquiring possession, if not outright ownership, of ½ the mill property (Sussex County Chancery Court Case Files 1855).

After William and Michael Stuart died, the ownership of their half of the mills becomes unclear. While James Stuart occupied and operated the mills during this period, there is no evidence he actually owned the property. His name does not appear as an owner in tax records, and there are no deeds indicating he acquired or sold the land. At some point during the 1850s, Lot Rawlins appears to have acquired the Stuarts' half of the mills, although the circumstances are uncertain. That there was a dispute or feud between Lot Rawlins and James Stuart seems likely, though. In Rawlins will, first recorded in 1856 (six years before his death), he stipulated that none of his children sell any of his real estate to Stuart, Stuart's heirs, or those who might sell to Stuart or his heirs, for a period of 50 years. If they did so, the title of the land would revert to Rawlins' other children (Sussex County Will Book M12:43-46). According to tax and deed records, Rawlins' sons and grandson maintained sole possession of the Middleford Mills until 1900, fulfilling Lot's wishes.

The problems between Lot Rawlins and James Stuart may have set back reconstruction of the gristmill longer than normally would have been the case. During the 11 years that the mill was inoperable, the town of Middleford began to decline, as businesses that relied on the mills faltered and residents moved away (Purvis n.d.). In 1857, Rawlins' sons, John M. and James, rebuilt the gristmill, using the foundations of the previous mill, and constructed a new sawmill to the east (Scharf 1888:1304-1305). Business revived, but it was too late to stem the town's downfall. For the next 40 years, the Rawlins brothers operated the Middleford Mills with considerable success, but concurrently witnessed the town's demise. For example, during the 1840s there had been seven or eight stores in Middleford, but by 1887 there was only one left (Scharf 1888). The last map of Middleford made in the 19th century illustrates the town and the mills in 1860, following a survey made as part of the estate division for Barclay Townsend, deceased. The map illustrates the two mills, the town of Middleford, the mill pond, and the waste gates for the pond (Figure 11; Sussex County Orphans Court Vol. AA-28).

Beginning in the second half of the 19th century, industry censuses and insurance records provide detailed accounts of the Middleford Mills, their components, and their products. In 1850, census takers recorded no industry at Middleford, as the gristmill had not been rebuilt yet (Census 1850). By 1860, however, the takers described a gristmill, a sawmill, and a carding mill. The carding mill had been constructed in 1859 (Scharf 1888). The gristmill used water power and two sets of milling stones to process wheat, buckwheat, corn, and other grains. The sawmill used water power and two saws to turn timber into lumber. The carding mill, which the census noted was idle for 7 months of that year, also used water power to card wool. Although the census valued the gristmill and the sawmill equally (each were worth $3,000), the gristmill yielded over $7,000 worth of annual revenue, while the sawmill produced only $2,400 worth of yearly income. The carding mill, despite being valued at only $500 and "at rest" for 7 months that year, nevertheless produced $2,200 worth of income (Census 1860).

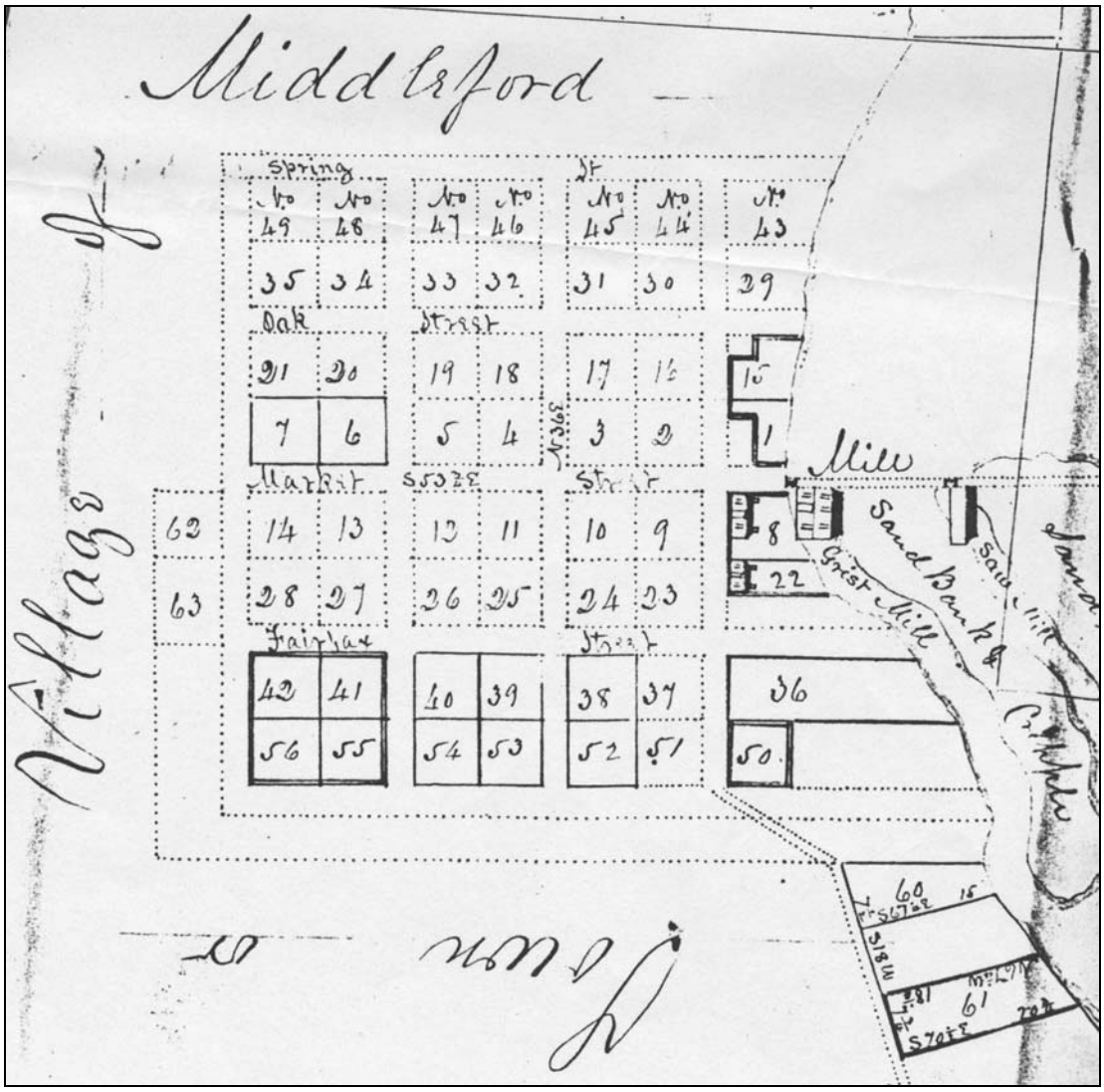


Figure 11: Middelford in 1860.

The 1870 industry census indicated that there were now four mills at Middleford: the gristmill, the sawmill, the carding mill, and a planing mill, built in 1864 (Scharf 1888). All were powered by iron water wheels. The gristmill and sawmill had a horsepower of 20 each, while horsepower for the planing mill and carding mill are listed as 18 and 10, respectively. Production was down from 1860 at both the gristmill and the sawmill (in 1870 the gristmill did $5,950 worth of business and the sawmill did $1,800 worth of business), but up at the carding mill (with a total of 3,546 in revenue). The planing mill, which used three circular saws to process mainly yellow pine timber, yielded $2400 in revenue that year. It was valued at $1,000 (Census 1870).

During the 1860s and 1870s, the Rawlins brothers took out fire insurance policies on the mill buildings from the Kent County Mutual Insurance Company. A policy in 1867 covered the planing mill, sawmill, and carding mill. According to the policy, the planing mill was a one-and-a-half-story frame building measuring 20 x 40 feet. It had

one room on the bottom floor, which contained the mill and one circular saw, with two additional circular saws on the upper floor. The sawmill was a single-story frame building measuring 20 x 50 feet. The carding mill consisted of a two-room, single-story frame building measuring 16 x 24 feet, containing two carding machines. The policy described the mill complex layout as well. The carding mill was located ca. 25 feet from the gristmill (which at the time was insured through another company), the planing mill was located ca. 64 feet from the carding mill, and the sawmill was located ca. 100 feet from the planing mill (Kent County Mutual Insurance Company Policy 2616). By 1873, the Rawlins brothers had transferred the gristmill policy to the Kent County Mutual Insurance Company as well. The policy described the building as two stories with a basement, measuring 30 x 40 feet. The basement had brick walls but the upper floors were wood frame (Kent County Mutual Insurance Company Policy 4364).

The 1860 industrial census shows that Lot Rawlins was operating a sawmill, gristmill, and carding machines. All were water powered, but the size and horsepower of the wheels is not given. The sawmill included 2 saws, and the gristmill 2 run of stones. The carding machines were not in operation 7 months of the year (Industrial Census 1860). The 1870 industrial census for Seaford Hundred lists a gristmill, sawmill, planing mill, and carding mill. Each was powered by an iron wheel; the gristmill wheel had 20 horsepower, the lumber mill 20 hp, the planing mill 18 hp, and the carding mill wheel had 10 hp. The gristmill was in operation 12 months of the year full-time, the lumber mill was in operation 10 months, the planing mill 6 months, and the carding mill 3 months. An 1867 insurance policy describes the carding mill as 25 feet from the gristmill, the planing mill as 64 feet from the carding mill, and the sawmill as 100 feet from the planing mill. Figure 12 shows a possible arrangement of these mills along the dam.

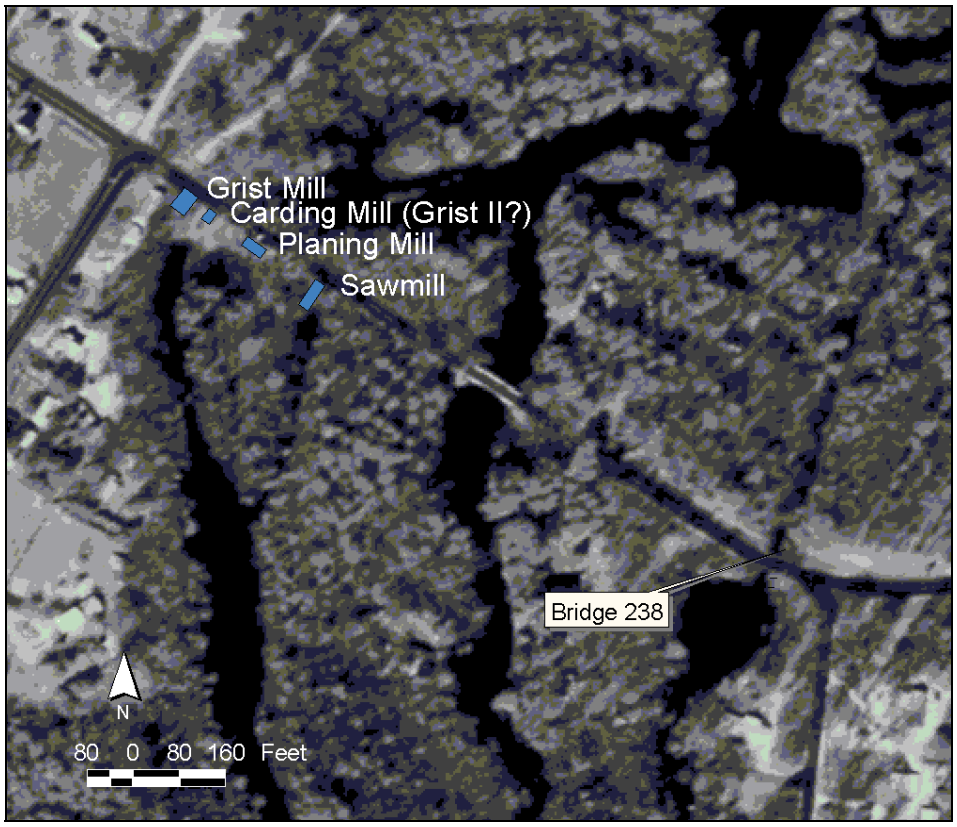


Figure 12: Possible distribution of mill buildings along dam.

This reconstruction assumes that the gristmill and sawmill were still in the locations suggested by earlier maps, that the carding mill shared a race with the gristmill, and that the arrangement of the buildings is linear. Of note is that the industrial census and insurance records suggest that there may have been an additional race that is not shown on earlier or later maps, and is no longer visible, but that lay between the race for the grist and carding mills and the race for the sawmill. In 1880, the industrial census describes the gristmill as having 2 wheels with 6 feet of head, one of 36 feet in diameter with 25 hp, and another of 30 feet in diameter with 15 hp. It also lists a sawmill with one wheel of 48 feet in diameter, 7 feet of head, and 18 hp. There is no mention of a planing mill or carding mill; perhaps the second wheel listed for the gristmill had previously been used for the carding mill. Both the sawmill and gristmill are described as in full operation 12 months of the year.

The Middleford mills continued to operate until the 1890s, when the deaths of both Rawlins brothers caused the business to fold. Their heirs put the mill property up for sale, but there were no takers until 1900, when Robert Purvis, a former machine shop owner from Philadelphia, and more recently Laurel Springs, New Jersey, purchased the land and the mill buildings (Sussex County Deed Book 135:85). He moved his manufacturing operations into the old gristmill, although he was unable to harness

enough water power to run his machines, and instead had to use steam and gasoline engines (Purvis n.d.).

A map of the Middleford Mills area was made in 1900, when the heirs of John M. Rawlins sold the property to Purvis (Figure 13; Sussex County Deed Book 135:85). The plot indicated that the ca. 114 acres of land included the northwestern 100 acres of the original Brother's Agreement, plus additional lands within and adjacent to the mill pond. The map also shows that the four mill races were still in place. A circular-shaped area downstream from the Bridge 238 area suggests that race experienced some dredging, quarrying, or excavations just below the dam. The roughly circular depictions match current aerial maps, which show these areas as well.

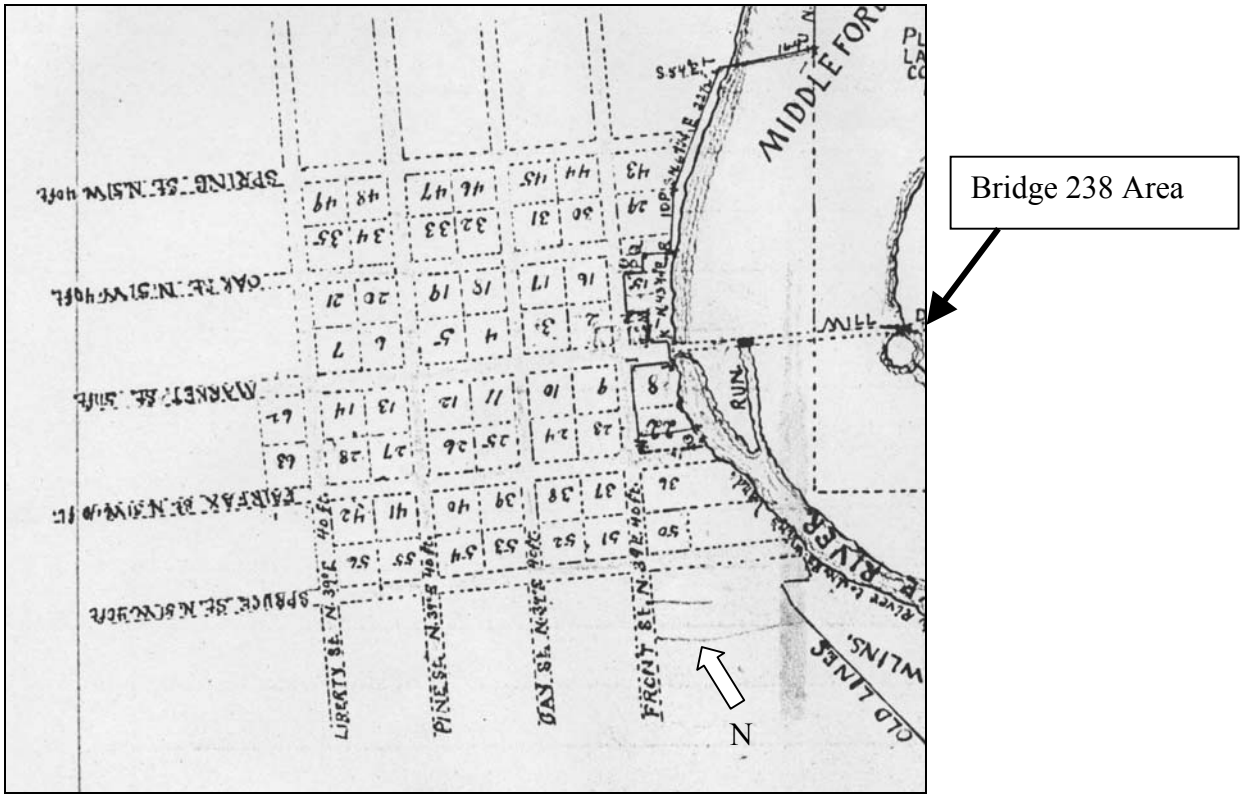


Figure 13: Middleford and the mills in 1900.

At some time during the first decade of the 20th century, the Middleford Mill pond ceased to exist. A probable breach in the dam rechanneled the main course of the Nanticoke River through the dam's middle waste gate, which currently flows under Bridge 237. A map of Middleford made ca. 1908 shows that the mill pond still existed as of that date (Figure 14; Friedel 1970). However, by the time the earliest U.S.G.S. map of the area was made in 1915, the river's course ran through the middle waste gate, and the mill pond no longer existed (Figure 15). The pond's former location contained marshland (U.S.G.S. 1915).

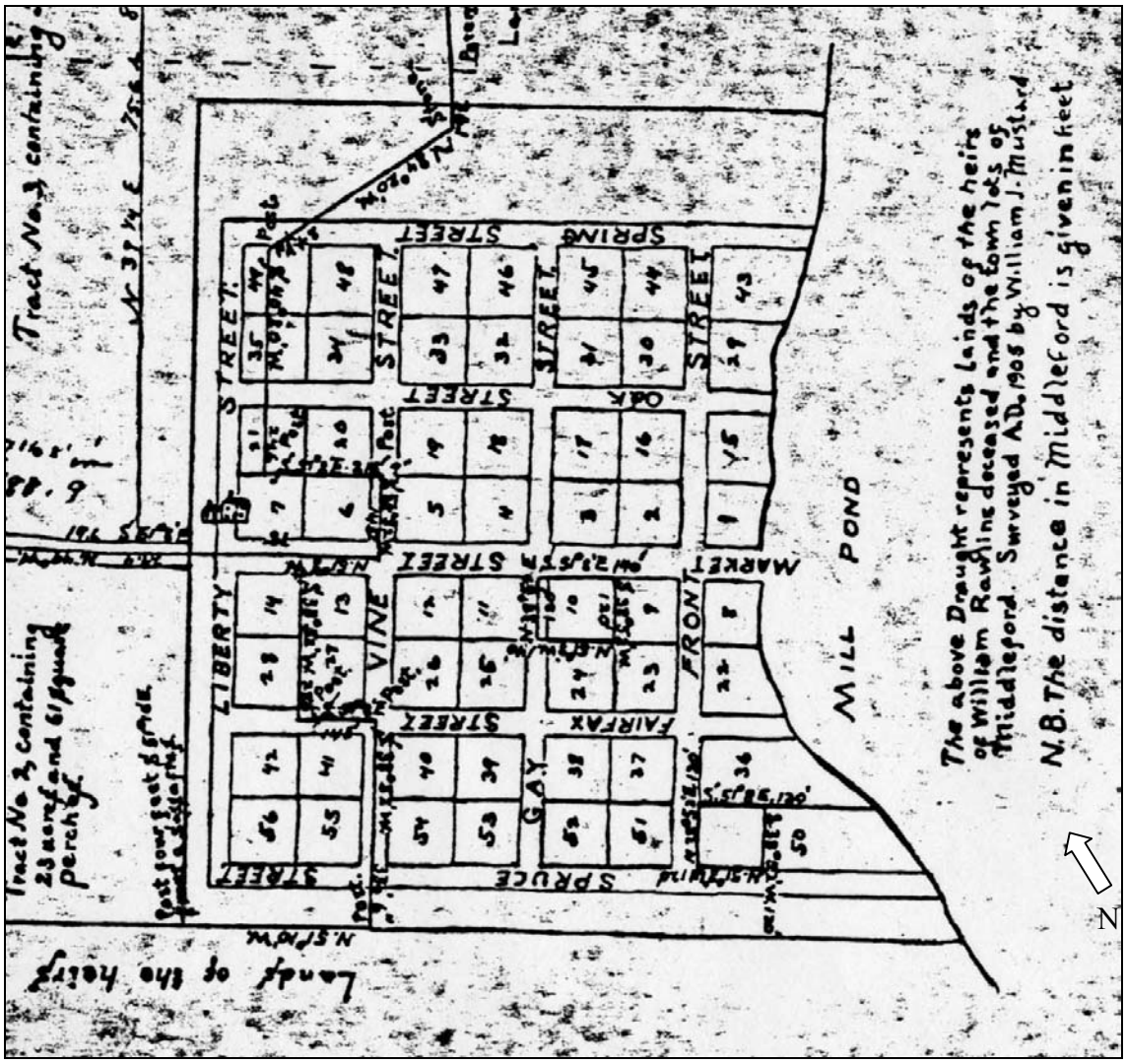


Figure 14: Middelford and the mills in 1908.

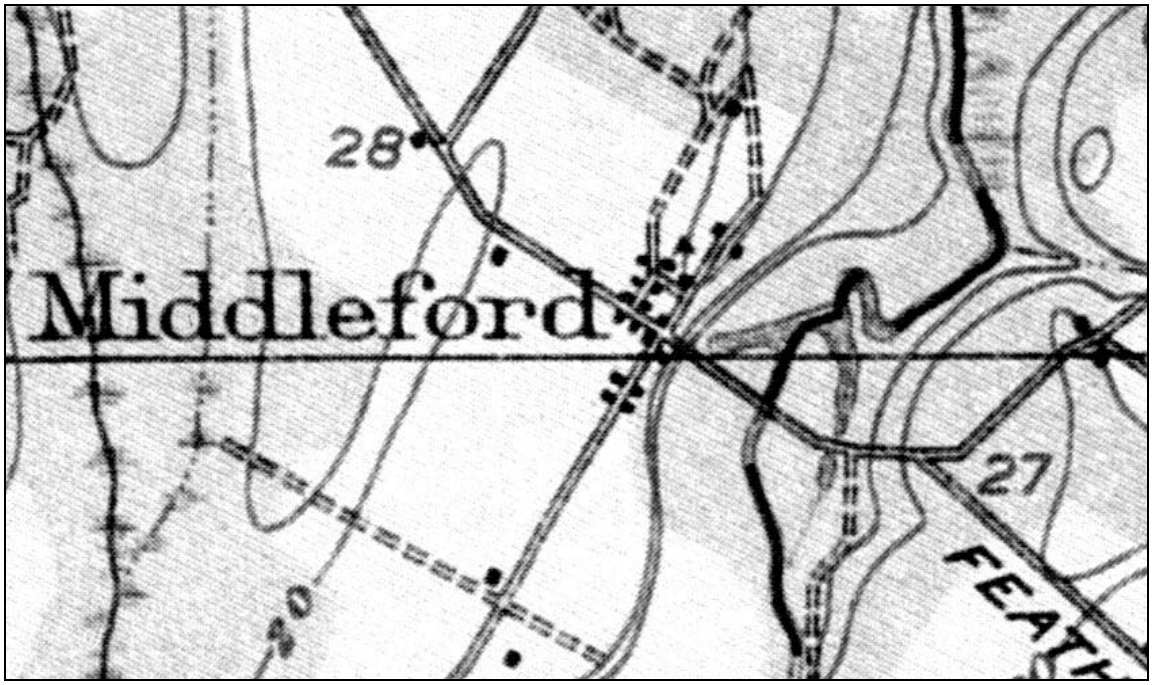


Figure 15: Middleford and the mill area on the 1915 Seaford Quadrangle USGS map.

Robert Purvis died intestate in 1921. Since he had no wife at the time, his property passed to his children. Through a series of deeds in 1923, his son John became the owner of the former gristmill and the town lot on which it sat, and his four daughters and their husbands became the owners of the remainder of the Middleford Mills tract, totaling 113 acres of land (Sussex County Deed Book 239:548-551; 552-554). None of the Purvis heirs lived in Middleford at the time, and the property appears to have sat largely unoccupied for the next 20 years.

In 1932, the widening of what would become S 46 necessitated demolition of the former gristmill, which still housed Robert Purvis' machine shop equipment. The timbers of the building were still usable, and were distributed to various individuals for reuse. South of S 46, across the street from the gristmill site, the same man who dismantled the mill erected a new concrete-block building where the machinery was transferred, although it was never employed (Purvis n.d.). Bridge 238, a timber stringer span that replaced a corrugated iron pipe bridge, was constructed in 1936 (Spero 1991).

In 1943, Purvis' heirs sold the mill tract to local land speculator H. Rafe Griffith (Sussex County Deed Book 340:225-228). He in turn divided the property into smaller parcels, and resold them to individual buyers two years later. Some of these parcels were formerly under the waters of the mill pond. The division of the mill tract into residential lots in 1945 marks the end of the Middleford Mills history. Since 1945, all of the parcels

have changed hands, some several times. Today, the area supports various types of residential structures.

THE MIDDLEFORD COMMUNITY

Even though Jonathan Vaughan and partners from Pennsylvania first developed industry in the Middleford area in 1763, little is known about the region until the first part of the 19th century (Munroe 1978:201). The three main themes of Middleford's community history relate to the ownership of lots and businesses in town, occupations of Middleford residents, and the ethnic identity of residents. Some of the residents owned lots in town, but others rented houses and businesses, mostly from the largest landowners in Middleford, who were generally owners of the mill complex. Middleford developed into a thriving community of just over 400 people of many different occupations relating to the mill industry by the mid-1800s, generally declining from that high point to the end of the 19th century. Finally, Middleford also counted many free persons of color among its citizens prior to the Civil War, even though many local residents still owned slaves. Research into development of Middleford town lots was used to create artist birds-eye-view reconstructions of the town and mill area at various points in its history. These are shown in Figures 15, 16, and 17.

Founding the community:

The Huffington brothers (James and William, Jr.) and Thomas Townsend acquired the land containing the old Nanticoke Forge in January 1805 from the estate of Joseph Pennell through an Act of the General Assembly (SCDB AB25:114-117). The three had been involved with the purchase of other milling operations and were expanding their ventures. On January 20, 1805, just a few days after the acquisition, the trio formed the milling group entitled the Middleford Company, and the tract to the west of the millpond was to be known as Middleford (pronounced locally as Middle-FORD) (SCDB Z24:338-339).

> "*...Article the first, Resolved that we the contracting partys do mutually agree to make the above described premises known by the name of Middleford in place of Nanticoke forge also do assure to ourselves in the above mentioned partnership the name and title of the Middleford Company..."* (SCDB Z24:338-339).

Figure 16: Bird's-eye view of Middleford Mills ca. 1834.

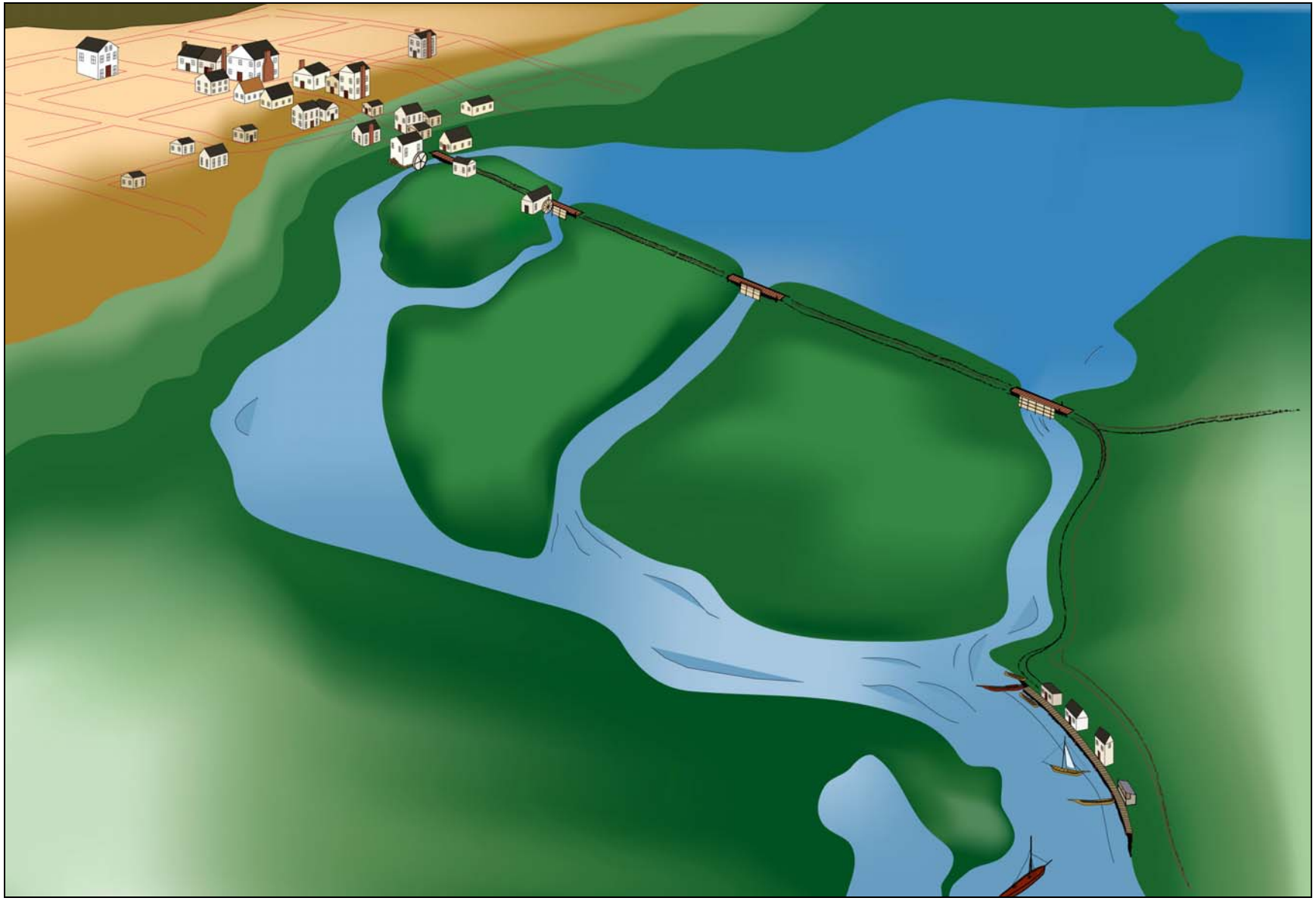


Figure 17: Bird's-eye view of Middleford Mills ca. 1846 showing more development along Front Street.

The Nanticoke Forge had been in operation since at least the mid-1760s, and more than likely some structures were present in the region when the Huffington and Townsend group purchased the land. However, the composition of the workers and residents in the area between the 1760s and 1805 is unknown. Since the area was apparently not developed as a town or a named community until 1805, no name can be used to tie the local population with an exact location. If any residences or commercial buildings were located on the property purchased for Middleford in 1805, they were not illustrated on the plot in the deed book drafted at the time of the purchase (Figure 18).

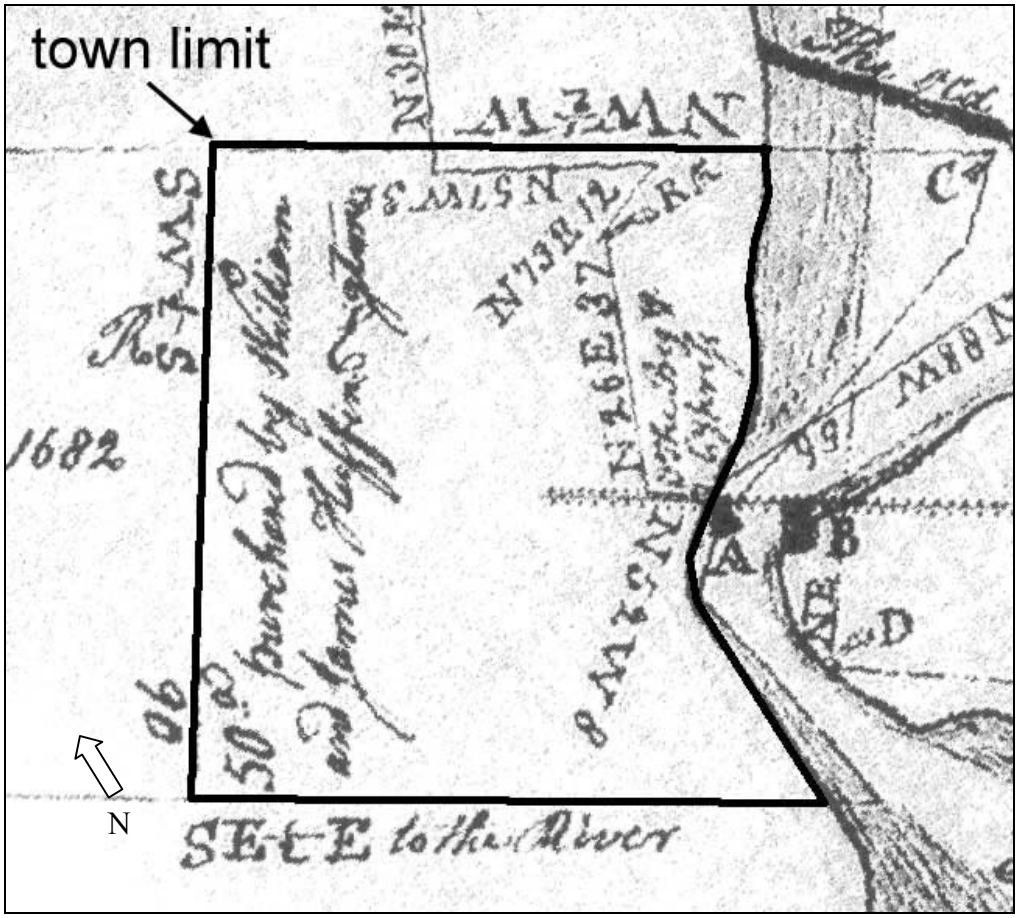


Figure 18: The Venture Tract, the future site of Middleford for the Huffington brothers and Thomas Townsend in 1805 (Kent County Warrants and Surveys B9 #177).

Scharf (1888) suggested that the names of "Brother's Agreement", "Company Lot", and "Venture" were titles assigned to the three tracts prior to the Huffington and Townsend purchase in 1805, perhaps as early as the mid-18th century. However, the first mention of the formal titles does not appear until 1805, in the deed when the two Huffington brothers and Townsend agreed to purchase the old forge and mill site, form a new company, and embark on a new venture by plotting out a new town named Middleford. In essence, the names probably originate in the 1805 document and not from

an earlier transaction. To further support this statement, the boundary of the "Venture" tract closely matched the boundaries of the newly plotted town. It is suggested that the names were given to at least "Brother's Agreement" and "Venture" when the 1805 transaction transpired. The land under ownership of the Middleford Company encompassed both sides of the Nanticoke River, with some land to the south of where the new dam would be constructed and the majority above (or to the north) encompassing the older Nanticoke Forge dam and races (Figure 15).

The above agreement mentioned that lands owned by the company within the town of Middleford would be either sold and given directly to the purchaser without further concern by the company, or used by the company for their own purposes (SCDB Z24:338-339). This opened the door for the purchase of lots that were apparently laid out to the west of the mills as early as 1806. No doubt, the Huffington brothers and Townsend were eager and hopeful the community would thrive and grow. The original town of Middleford was laid out containing at least 63 lots, averaging two acres each. It is assumed that the company had a plat where they could draft the locations of their tracts and those sold to patrons, but there is no evidence of this. Thomas Townsend sold his portion of the operation to William Huffington, Jr., in August 1805, just a few months after the trio purchased the mill and adjacent tracts. James Huffington, Jr., sold his interest in the mill and other tracts to William Huffington, Jr., in 1807 for just over $4,000, giving the latter full ownership of the operation (SCDB AD27:352-353).

The main road through town came north and east from Seaford, crossed the mill dam and races, and continued eastward to Georgetown. Market Street was an extension of the road across the dam and races. Other streets in town parallel to Market Street were Spring, Oak, Fairfax, and Spruce. The cross streets were Front (along the river), Gay, Vine, and Liberty. All of the streets were 40 feet wide, except for Market Street, which was 50 feet wide (Sussex County Orphan Court Case File Barkley Townsend 1858).

The Town Lots:

A year and a half would pass after the naming of Middleford before anyone purchased a lot in the village. Only 12 lots (19%) were purchased directly from the mill company in the first 40 years of Middleford's existence. On December 12, 1806, Daniel Oney, a free person of color, became the first person listed in the Sussex County deed books to purchase a lot in the community (SCDB AC26:396-397). Oney paid $25 for Lot # 29, located adjacent to the west side of the millpond north of the dam (Figure 19). At the time, Oney was also the only free person of color in town (1807 SCTA).

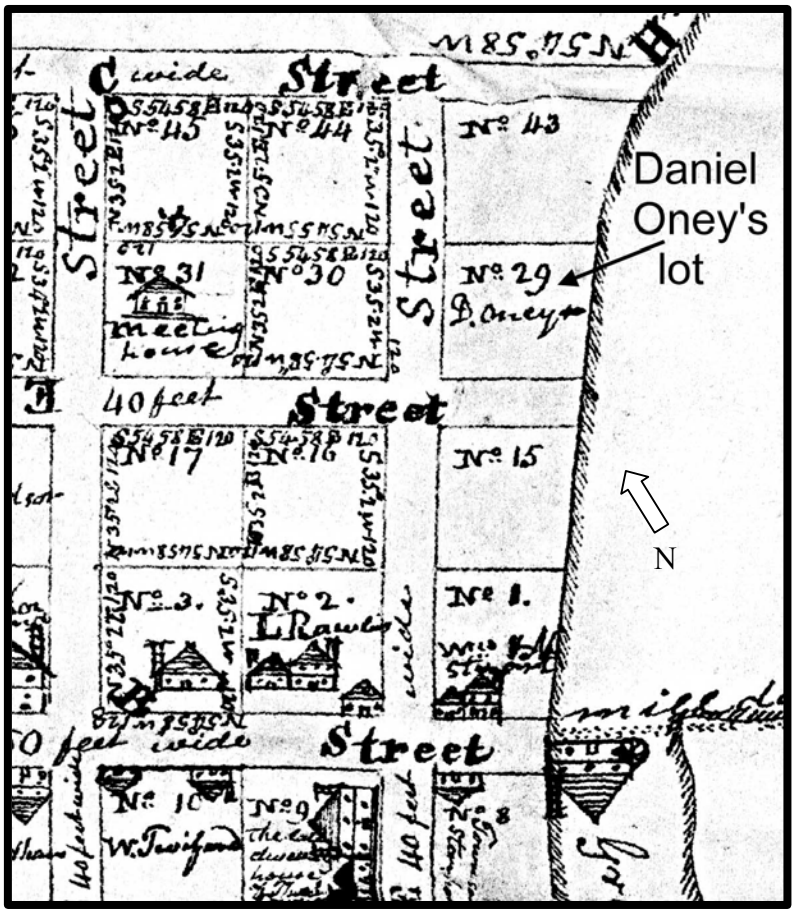


Figure 19: Portion of 1831 Middleford plat with Daniel Oney's lot.

More than likely, Daniel Oney's lot did not contain a structure when he purchased it, as reflected by the low price. The majority of the early lots sold in Middleford from 1806 to 1812 ranged from $25 to $65 with no mention of buildings on the premises (Table 1). In 1811, Daniel Trimbal purchased a lot for $450 and houses were mentioned in the deed transaction, with the price suggesting a rather substantial structure (SCDB AF29:336-337). Frequently, Probate or Orphan Court records provide information on structural analysis, but none has been found yet for Middleford buildings aside from the mill operations.

Table 1: List of original owners of the private lots sold in Middleford from 1806 to 1825.

Name	Occupation	Lot	Date	Instrument	Amount
Oney, Daniel (free person of color)	Unknown	29	December 12, 1806	SCDB AC26:396-397	$25
Needham, Michael	Unknown	11	February 5, 1807	SCDB AE28:313-314	$60
Ellingsworth, William	House carpenter	4	February 5, 1807	SCDB AC26:397-398	$30
Dulaney, William Jr.	House carpenter & joiner	S ½ of 22	March 28, 1809	SCDB AE28:326-327	$35
Hudson, Daniel	Blacksmith	5	August 29, 1810	SCDB AF29:337	$50
Dulaney, William Jr.	Unknown	18	February 26, 1811	SCDB AF29:335	$40
Carey, Mitchell	Unknown	37	May 10, 1811	SCDB AF29:335-336	$50
Trimbal, Daniel	Unknown	23 and houses	April 20, 1811	SCDB AF29:336-337	$450
Short, Isaac	Unknown	10	May 14, 1812	SCDB AG30:223-224	$65
Rawlins, Lot	Unknown	2	November 26, 1817	SCDB AL 34:3-4	$100
Elliot, Hooper	Ship carpenter	51	April 10, 1824	SCDB AO37:186	$100
Stuart (Stewart), William	Unknown	1	November 19, 1825	SCDB AO37-206-207	$450

The mill owners retained ownership over most of the town. Deed records indicated that only five town lots had been sold by 1810. Over 88 people were listed in the census ten years later (1820 Federal Population Census for Sussex County, Delaware). Only 12 deeds were discovered in the deed books where patrons purchased directly from the Huffington and Townsend families (basically the company) for lots in the village of Middleford. Whether by intention or not, the ratio of lots sold compared to the number of people listed as residing in the community, indicated that early on, most residents rented from the mill company. It is probable that the company intended to sell all the lots in Middleford to individuals or other speculators but could not find a

significant number of buyers for the 63 lots. Not being able to "unload" the lots, the various owners of the mills kept selling them to the next mill purchaser. Middleford appears to have been a company town.

By the time that Middleford was 25 years old (1830), Thomas Townsend had died and his son, Barkley Townsend inherited the mills and a large percentage of the town. Thomas' widow married Alexander Campbell (Sussex County Orphan Court Case File Barkley Townsend 1858). The town could boast a population of just over 130 inhabitants, and the post office had just been established. Thomas and Mary Townsend had donated Lot 31 to the Methodist Episcopal Church for a Meeting House, which was constructed by 1831 (SCDB AQ39:238; Act of the General Assembly 1833:246-247).

Barkley Townsend married Leah (maiden name unknown) on August 15, 1826 and died June 4, 1857 (Sussex County Orphan Court Case File Barkley Townsend 1858). He received the following lots in Middleford from his father Thomas' estate in 1832: 6, 7, 9, 12, 13, 14, 23, 24, 25, 26, 27, 28, 30, 36, 38, 39, 40, 41, 42, 43, 50, 53, 54, 60, 61, 62, 63 (Figure 20). As the 1831 plat indicated, the main row of structures in the town at that time were aligned east-west along Market Street (Figure 21). People coming across the dam road from the east would be able to look down Market Street and see the majority of the community in a single view.

William and Michael Stuart (a.k.a. Stewart) had lived in the Middleford area and had been buying up a few of the lots in town. Michael Stuart owned a grocery store and a son or nephew, James Stuart, was one of the earliest, if not the first, postmaster for Middleford (Blair and Rives 1836:97). Lot Rawlins, just as the Stuarts, had also been purchasing lots in town, and his son, John M. Rawlins, was postmaster by 1859 (Leech 1859:96). The fact that both the Stuarts and the Rawlins would own part and/or all of the mill and over half the town, as well as the grocery and post offices, indicated how involved the company owners were in the community, or company town.

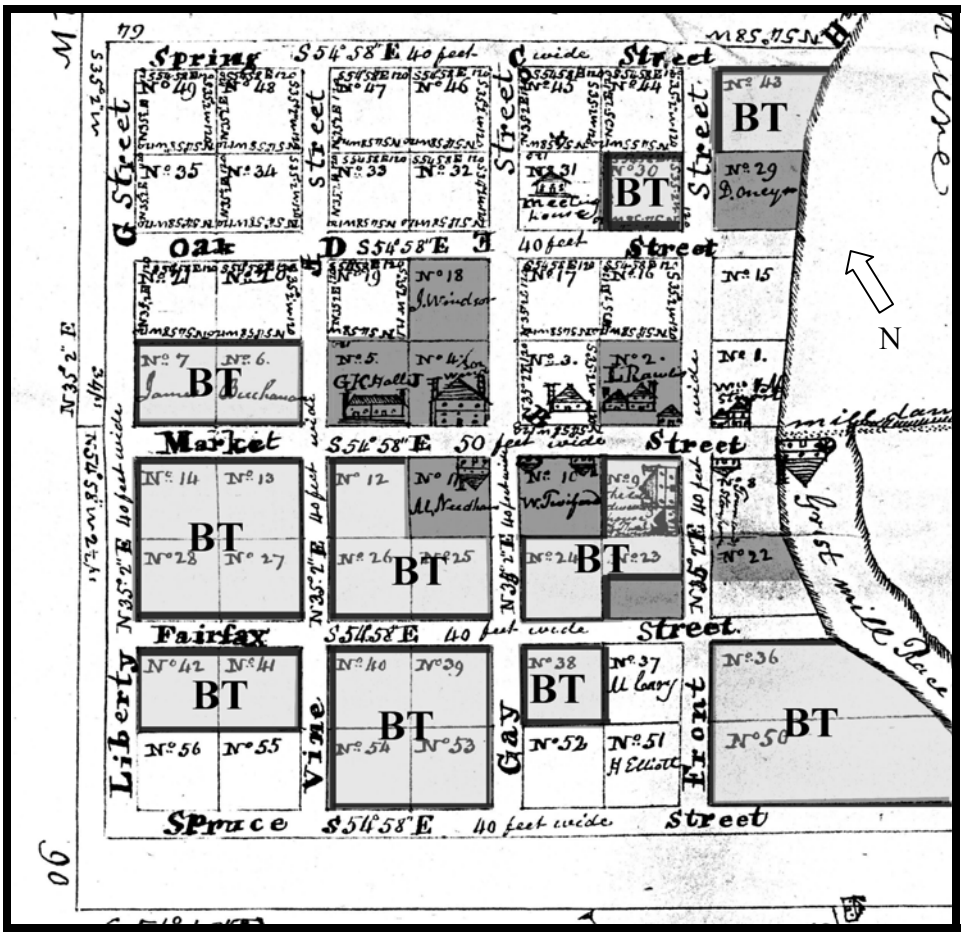


Figure 20: Barkley Townsend lots in 1831 (BT) with privately owned lots (dark grey).

Figure 21: Enlargement of 1831 plat of Middleford showing the majority of the buildings were oriented along Market Street at that time.

A few of the Middleford town tracts were plotted when they were sold or transferred, relating information on the house size, shape, and location within the tract, including a well location (Figure 22; SCOC Case File for Mitchell Carey 1835). Figure 22 also contained information on the two neighboring tracts, showing they belonged to James Stuart and the mill property owners.

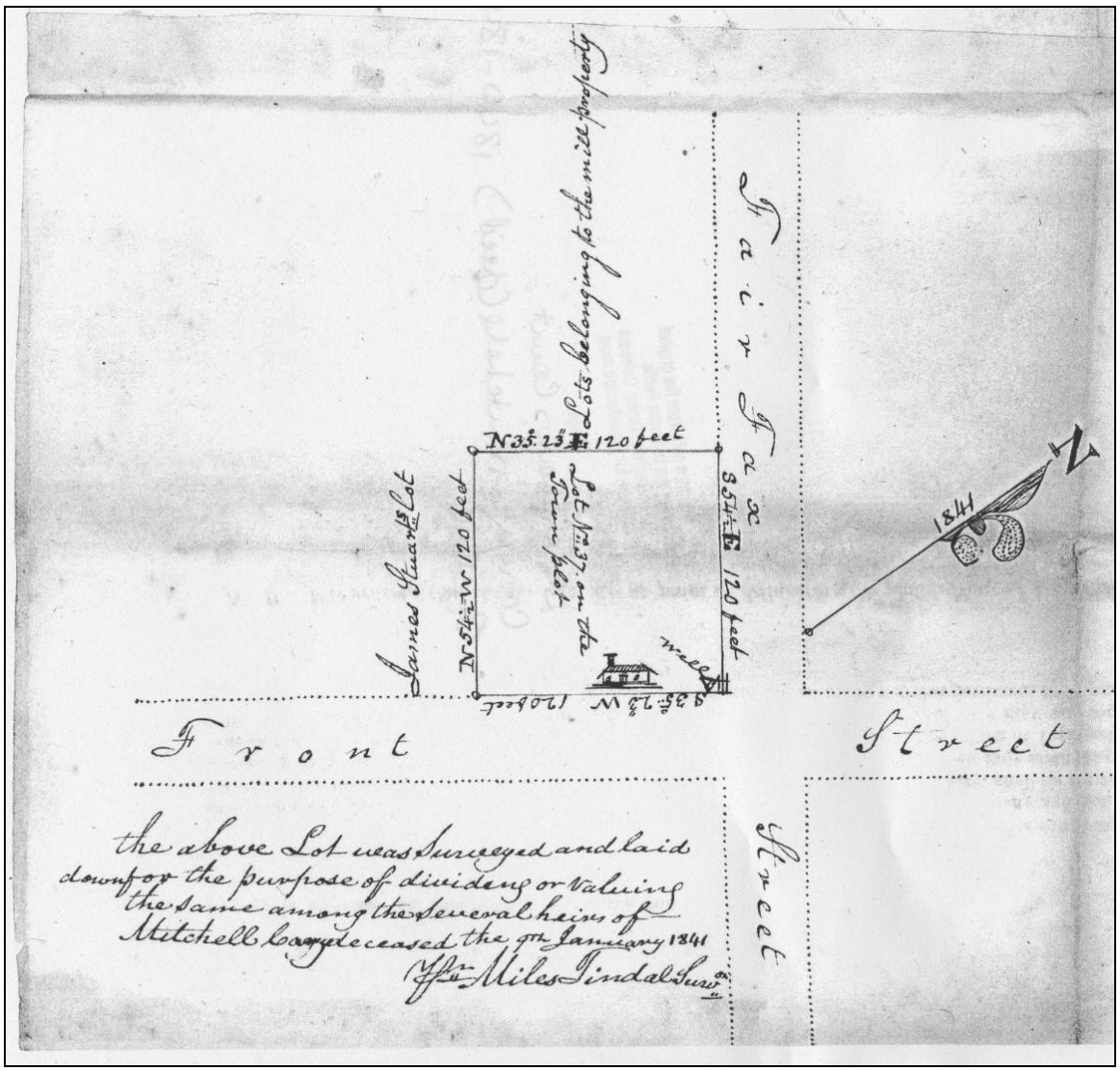
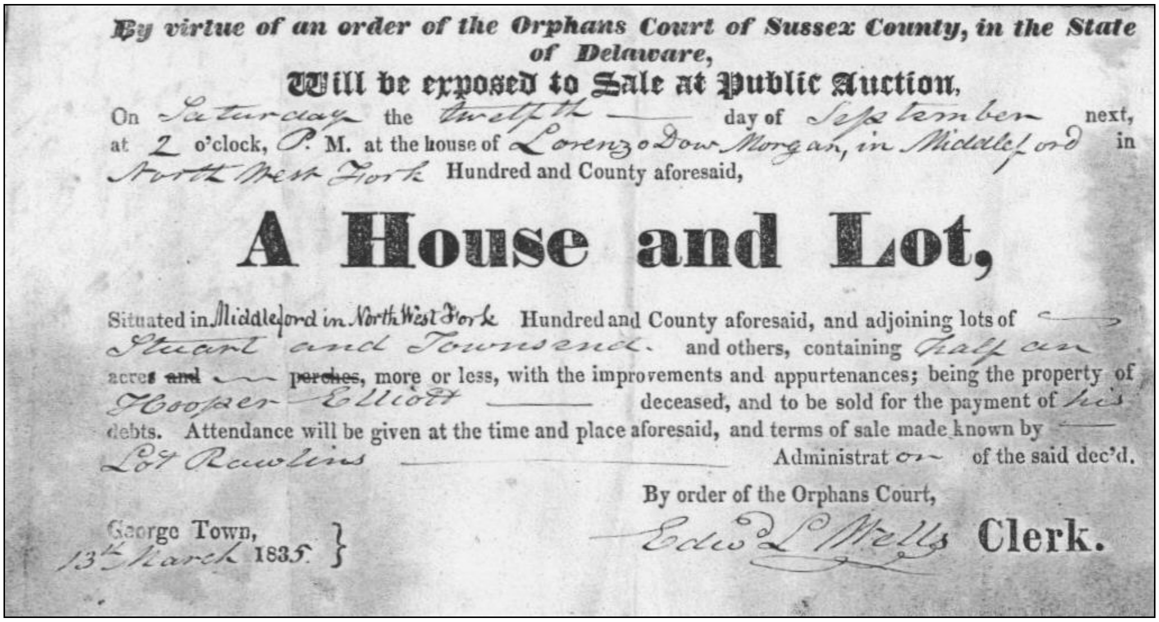


Figure 22: An 1835 plot of Mitchell Carey's Lot #37 in Middleford with a well near the corner of Fairfax and Front Street (SCOC Case File for Mitchell Carey 1835).

Sale bills for auctions and land sales were placed in each surrounding community to bring as much interest to the event as possible (Figure 23). The reverse side of the following sale bill provided the names and locations of ten sale bill signs posted in the region for the sale of Hooper Elliot's lot at the house of Lorenzo Dow Morgan (Figure 24).



By virtue of an order of the Orphans Court of Sussex County, in the State of Delaware,

Will be exposed to Sale at Public Auction,

On Saturday the twelfth day of September next, at 2 o'clock, P. M. at the house of Lorenzo Dow Morgan, in Middleford in North West Fork Hundred and County aforesaid,

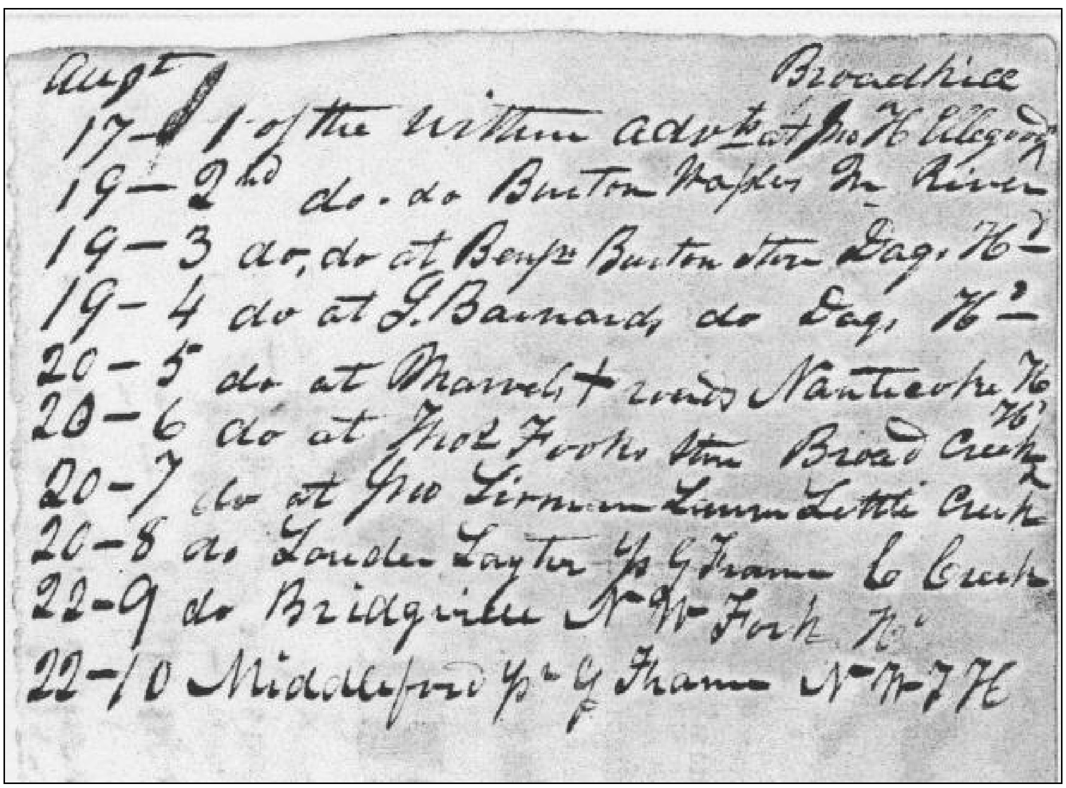
A House and Lot,

Situated in Middleford in North West Fork Hundred and County aforesaid, and adjoining lots of Stuart and Townsend and others, containing half an acre ~~and~~ perches, more or less, with the improvements and appurtenances; being the property of Hooper Elliott deceased, and to be sold for the payment of his debts. Attendance will be given at the time and place aforesaid, and terms of sale made known by Lot Rawlins Administrator of the said dec'd.

By order of the Orphans Court,

George Town, 13th March 1835. } Edw^d L Wells Clerk.

Figures 23: Front of a sale notice for Hooper Elliot's Lot #51 and house in Middleford in 1835.



Augt Broadkiln

17–1 1 of the written advt at Jno H Ellegood

19–2nd do. do Burton Wapples Mr River

19–3 do, do at Benjn Burton store Dag. Hd

19–4 do at J. Barnard, do Dag, Hd

20–5 do at Marvel + roads Nanticoke Hd

20–6 do at Thos Fooks store Broad Creek Hd

20–7 do at Geo Lirman Laurel Little Creek Hd

20–8 do Lowder Layton Hs G Frame & Creek

22–9 do Bridgeville N W Fork Hd

22–10 Middleford Hs G Frame N W F Hd

Figures 24: Back of an 1835 sale notice for Hooper Elliot's Lot #51 and house in Middleford listing the places the bill was advertised, including Middleford.

When the Middleford lots were distributed among Michael Stuart, William Stuart and Lot Rawlins in 1846, almost all of the lands were lots that Barkley Townsend had received from his father, Thomas (Figure 25). The Rawlins family would still retain a large portion of the mill tracts and the town of Middleford until the end of the 19th century. Letters about purchasing timbers from Pennsylvania to build the mills and races still survive (personal conversation with Dr. John Rawlins, October 5, 2001). The 1846 plat of the community illustrated an alignment of structures along Front Street, whereas in 1831 there was an alignment along Market Street (Figure 26). The shift could represent different building phases that may be difficult to identify in the archival record. It is also possible that the 1846 map only illustrated the buildings constructed since the 1831 plat.

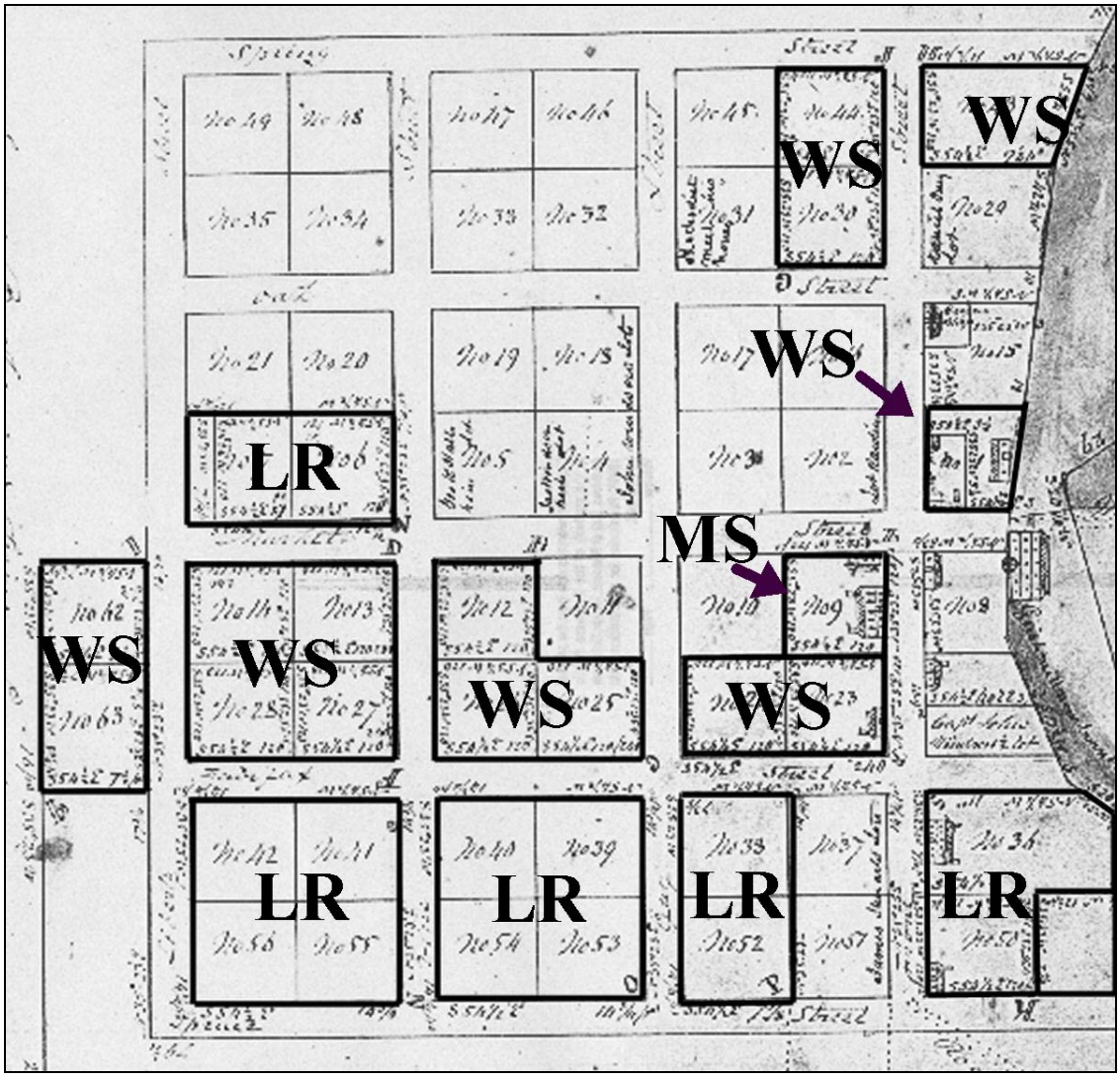


Figure 25: Middleford lots given to the Stuart brothers (WS = William; MS = Michael) and Lot Rawlins (LR) in the 1846 distribution (SCCC Volume C 1844-1859 between pages 92-93).

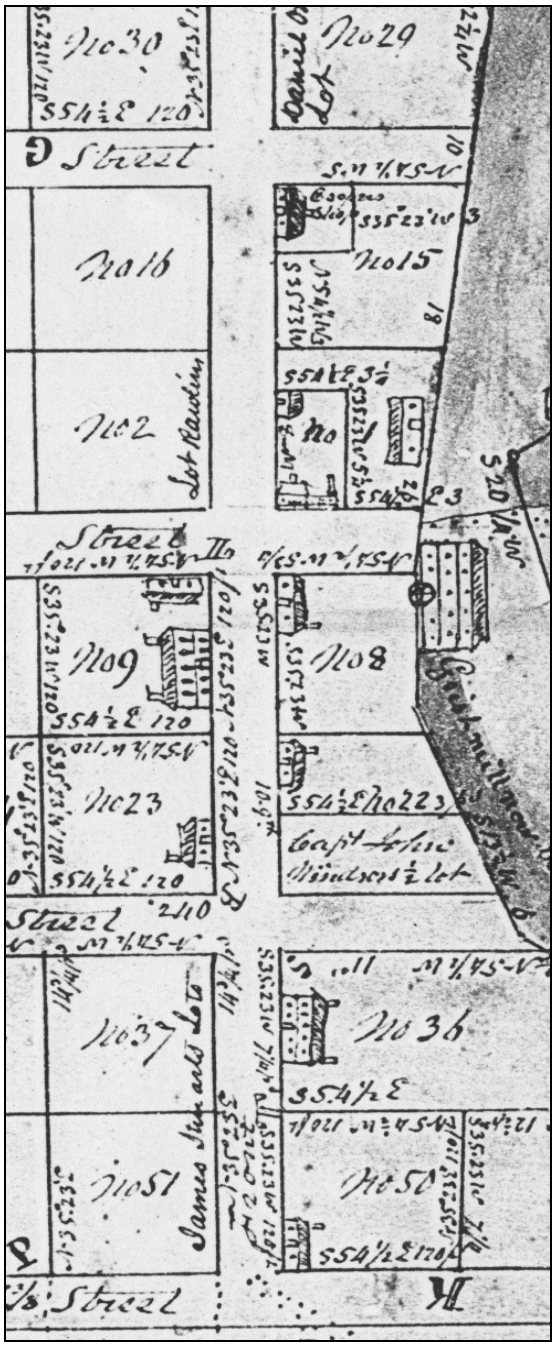


Figure 26: Enlargement of 1846 plat of Middleford showing buildings along Front Street.

The settlement of the Barkley Townsend estate took several years. Leah Townsend received portions of nine town lots, even though some of those lots had been distributed to Lot Rawlins and William Stuart in the 1840s, when part of the estate had been settled (Figure 27). As the community began to decline in population, Leah

Townsend sold her town lots she received from Barkley's estate selling the majority of the lots to the Rawlins family who, by then, owned the entire mill operation.

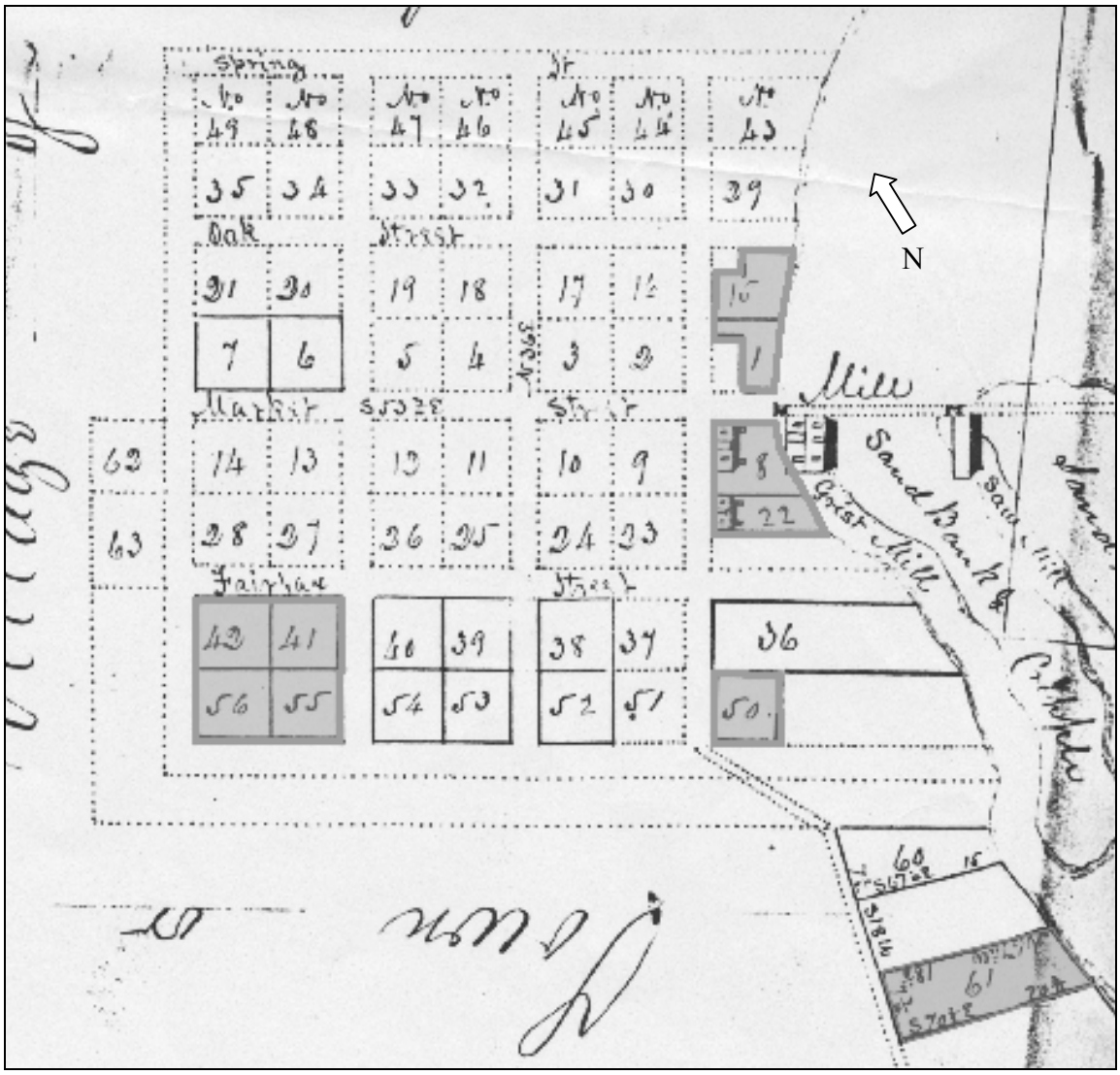


Figure 27: Plat of Middleford in 1860, with lands allotted to Leah Townsend, widow of Barkley Townsend (SCOC Division of Lands 1860 for Barkley Townsend dec'd).

A fire in 1846 left the Middleford Mills inoperable for almost a decade (Scharf 1888). This event occurred when Middleford was apparently at its peak of population and housing. The 1840 Federal Population Census showed the town with a population of 444 residents, a number that never again would Middleford be able to match. During this time frame, the Rawlins family assumed control from the Stuarts and Mrs. Townsend. Although the resulting down time may not have originally destroyed the town, after the Civil War, the population began to rapidly decline. The Delaware Railroad was constructed through the Northwest and Seaford Hundreds in 1858, bypassing Middleford and businesses continued to suffer (Conrad 1908:704-6). The reliance on water

transportation and rough overland routes was over, and the mariners moved away from Middleford, replaced by farmers and farm laborers.

The population of Middleford was cut in half by 1850 (221). However, after the mills were up and running in the late 1850s, the town population rebounded almost 30 percent (313) by 1860. The plat of Middleford in the 1868 Baist Atlas indicated the Rawlins and Stuarts still owned several outlying farms to the east of Middleford (Figure 28), as well as almost all of the buildings in town, at least those shown on the map, even though the Stuarts did not retain control of the mill operations (Figure 29). With declining profits from the mill-related industries, non-company homeowners were apparently moving away. The lack of income into the hands of individual families was also reflected in the declining number of residential structures in Middleford. With no money to live, these families would have had a hard enough time to provide food on the table, let alone have enough cash to build a new house. Therefore, the total number of houses in town, also declined in the latter half of the 19th century.

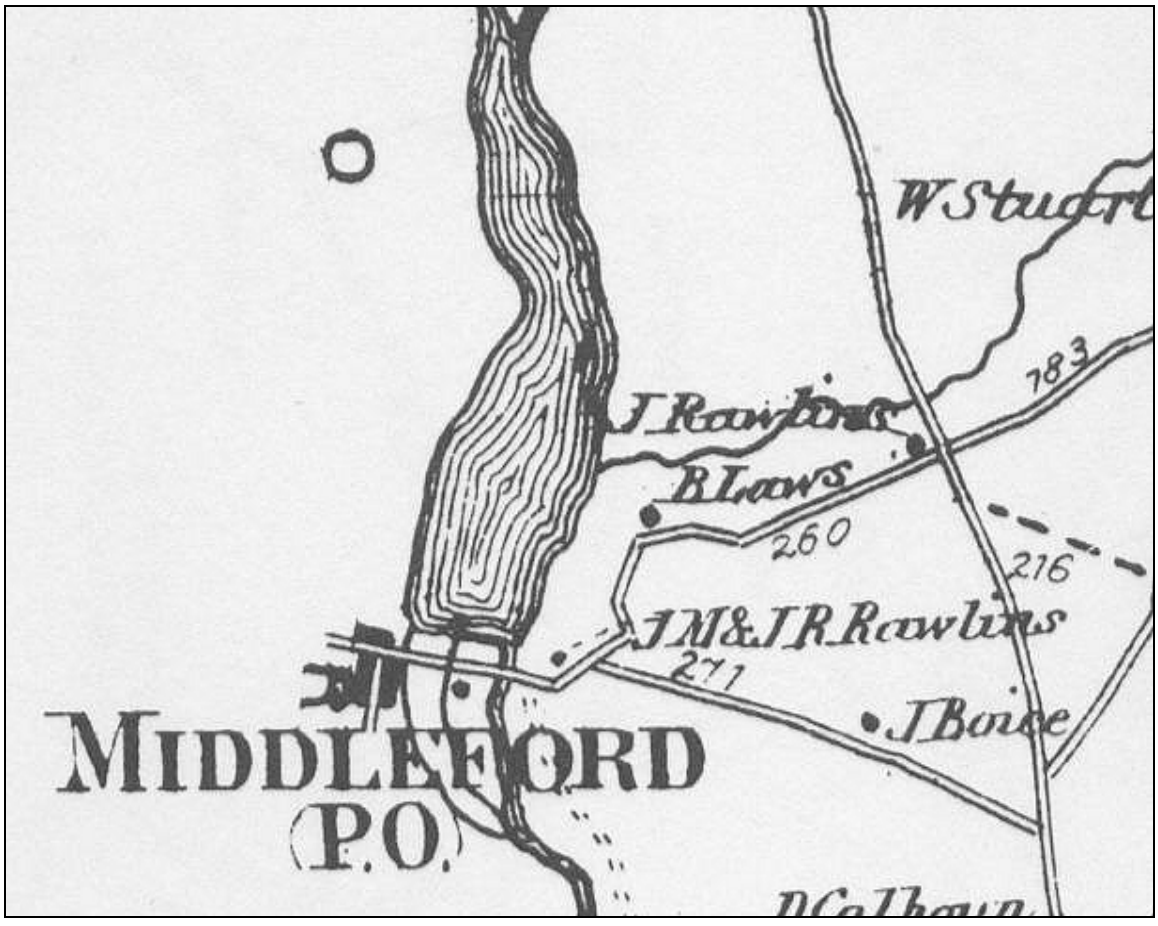


Figure 28: Plat from Baist's Atlas (1868) depicting only two main roads and streets in Middleford with lands of the Rawlins and Stuart families around the community.

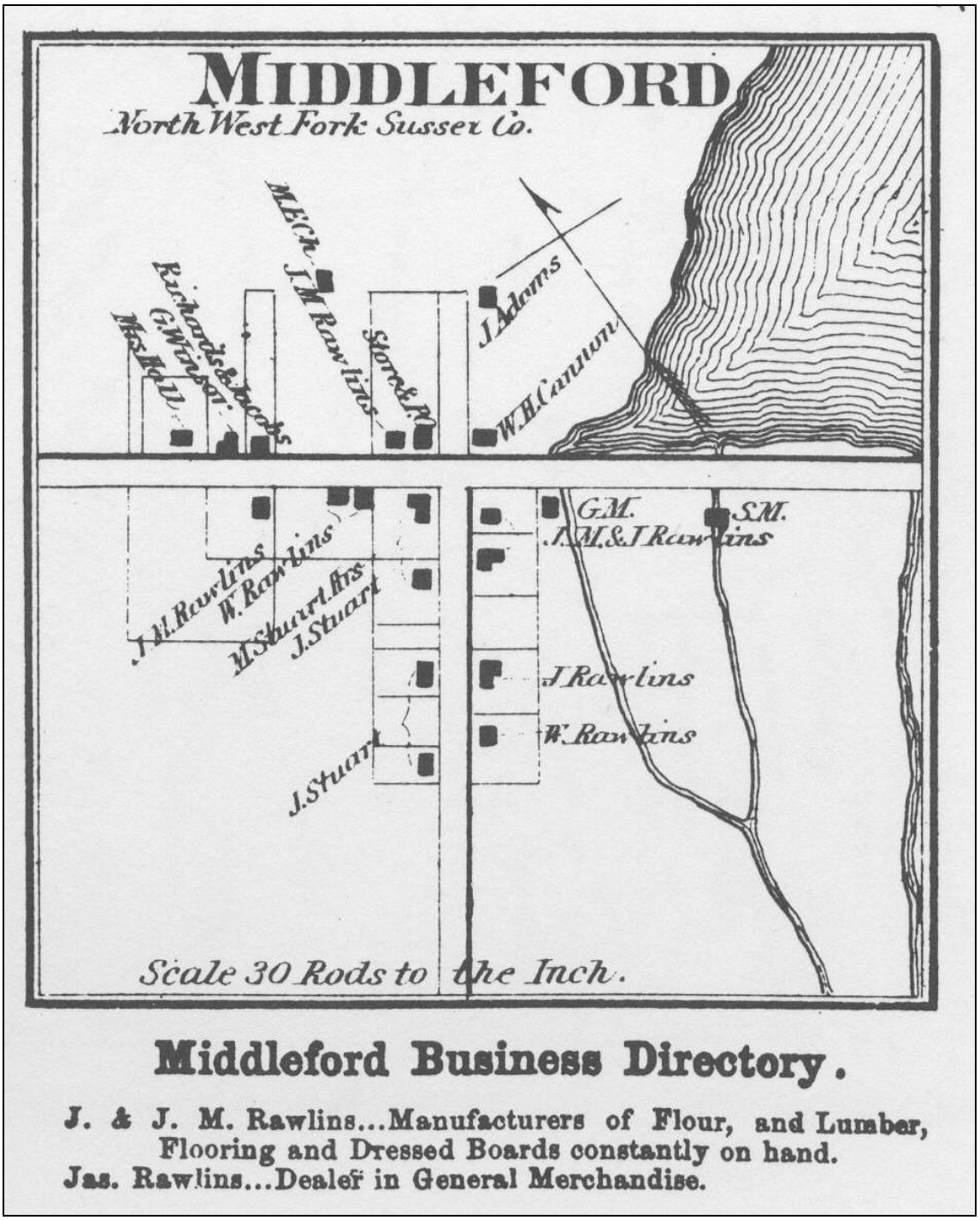


Figure 29: Plat of Middleford from Baist (1868) showing only two streets/roads in town with the numerous Rawlins and Stuart family holdings.

As the milling era in Middleford was coming to a close, the Rawlins family members sold the mill land and lots in Middleford. An 1895 United States atlas listed

Middleford as having a population of only 27, with a post office, but no railroad or express office (website livgenmi.com/1895). By 1900, most of the houses of the village were not depicted on a town plat (Figure 30). The Rawlins heirs had just sold the gristmill and other buildings with 114 acres of land to Robert Purvis in 1900, many years after the Rawlins brothers had died and the mills were shut down (SCDB 135:85). A 1904 gazetteer for Delaware listed Middleford as simply a post village in Sussex County on Nanticoke River without reference to mills or other industry (Gannett 1976:12). Only one house was shown on a plat of the community in 1908 (Figure 31).

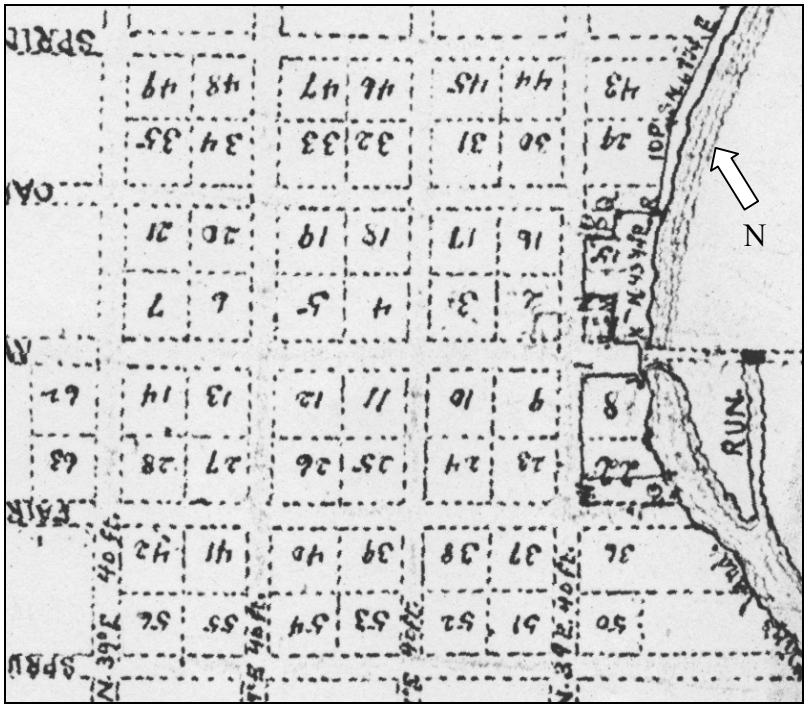


Figure 30: Middleford as plotted in 1900.

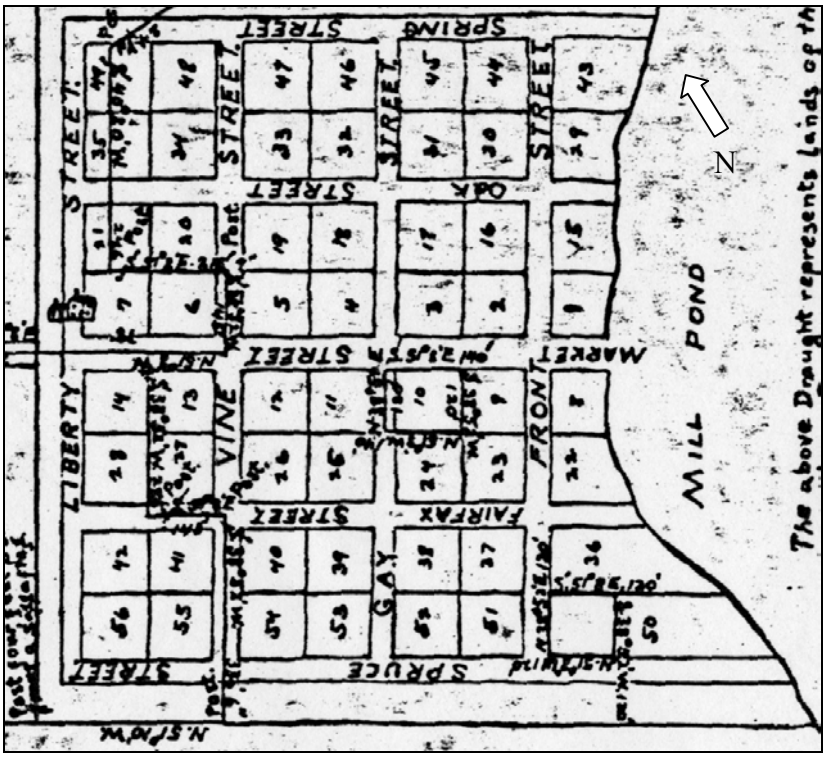


Figure 31: A 1908 Middleford plat map showed only one structure in town on the western edge of the community.

In 1908, the same year that Figure 31 (above) was drafted, the town of Middleford was described as being a small hamlet in Seaford Hundred, only containing a half dozen houses still standing from its peak days in the mid-19th century, all showing signs of decay (Conrad 1908:709). The number of buildings that Conrad described roughly corresponds with the number of pre-1900 buildings observed in 2001 during the preparation of this report. The Middleford population had dropped from 444 in 1840 to just under 60 in the surrounding area by 1900. Correspondingly, the number of households dropped from 44 in 1860 to a dozen in 1900.

The 1915 USGS Seaford Quadrangle map for the area illustrated 18 structures in the Middleford community, which could represent a construction "boom" (Figure 32). Even though the milling operations had ceased, the area was becoming a satellite community for the fast-growing town of Seaford just a few miles to the south. As previously stated, few pre-1900s houses exist in Middleford today, but the community is still as it has apparently always been: a small village next to an active creek, covered with trees and off the beaten path.

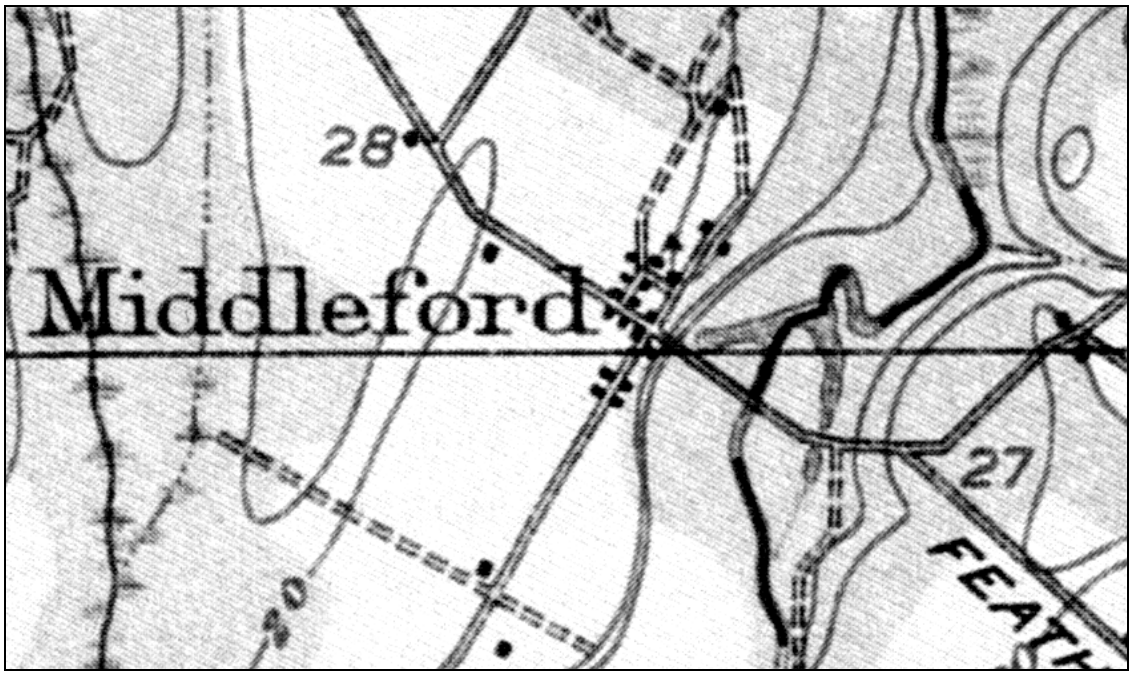


Figure 32: Middleford as represented on the 1915 USGS Seaford Quadrangle map.

The oldest business structure still standing in Middleford in 2001 is the old stock printing store (Figure 33). Previously located on the northeast corner of the intersection of Old Furnace and Middleford roads, the building was moved a few hundred feet north and put up on cinder blocks when the highway was widened. The majority of Middleford contains post-1900 houses with only a few isolated late 19th century dwellings.

Figure 33: Old stock printing store in Middleford.

The Town and Regional Residents:

As stated earlier, the number of residents in the region at the time Middleford was formally founded in 1805 is unknown, but the 1810 Federal Population Census indicated that at least 88 people were considered residents of the Middleford area. Few professions of these early Middleford residents were listed, however the community could boast a blacksmith, two house carpenters and joiner, ship carpenter, and ship captain among the first residents (Table 2). The fact that two house carpenters and a joiner were some of the earlier residents of the village could possibly attest to the early construction of the mill and related businesses or residences.

Table 2: Occupations of the early residents of Middleford (SCDB *passim*).	
Name	**Occupation**
Oney, Daniel (free person of color)	Unknown
Needham, Michael	Unknown
Ellingsworth, William	House carpenter
Dulaney, William Jr.	House carpenter & joiner
Hudson, Daniel	Blacksmith
Dulaney, William Jr.	Unknown
Carey, Mitchell	Unknown
Trimbal, Daniel	Unknown
Short, Isaac	Unknown
Rawlins, Lot	Unknown
Elliot, Hooper	Ship carpenter
Stuart (Stewart), William	Unknown

Between 1805 and 1900, the community contained the following professions:

- One of each a Captain, bricklayer, carriage maker, carriage trader, doctor/physician, domestic servant, post master, preacher, railroad bridge operator, school teacher, ship carpenter, shoemaker, teamster, wheelwright, and gristmill laborer.

- Two of each a boarder, house joiner, grocery merchant, clerk, coach trimmer, cook, miller, woodcutter, and sawyer.

- Also blacksmiths (3), carpenters (6), servants (6), coopers (3), day laborers (4), laborers (5), lumber mill workers (3), with the majority of the residents mariners (21), farm laborers (24) and farmers (32).

The shift away from a mill-based economy to a farm-based economy can be traced through the occupations mentioned in the census. Coopers, mariners/sailors, and carpenters/joiners that might have been directly associated with the mill operations were plentiful in the 1850 census, but declined to almost extinction by 1880. On the other hand, farm related jobs increased dramatically from 1850 to 1860, declining but still with a strong presence in the 1880 census. The loss of mariners/sailors was probably in direct relationship to the construction of the railroad in 1858, which bypassed Middleford, causing the transportation down the Nanticoke River to become cost prohibitive. The loss of regular laborers, as opposed to farm laborers, could be the drop in production at the mill operations. The decline in the number of servants from 1850 to 1880 and the rise of the number of those keeping house might be a change in the use of the two terms, but more than likely is a reflection of the number of people that could not afford to pay servants as opposed to having the wives keep house. The 1900 census cannot be used for

an accurate comparisons on local occupations since so few people lived in the town at that time.

Table 3: Middleford occupations from 1850-1880.

Occupation	1850	1860	1880
coopers	3	0	0
carpenters/joiners	5	3	1
mariners/sailors	19	6	2
servants	11	14	1
farmers	6	20	7
laborer	3	4	0
farm laborers	0	7	4
keeping house	3	7	25

The tax records for Sussex County did not indicate location of residents, which had to be compiled from census information. All heads of households were taxed on the same rates, regardless of race. Each head was taxed at $134 from 1807-1850, with a few well-to-do families being taxed at a rate of $150 per head of family. The tax records also contained information on pigs, sows, horses, colts, shoats, sheep, and ounces of silver plate, at a constant rate of $1.10 per ounce from 1807 to 1850 (SCTA 1807-1850 passim). Only seven households were reported in the 1807 tax assessments, the first documents revealing detailed information on the Middleford residents, and only 11 households were reported in 1809.

Table 4: Population analysis of Middleford from 1807-1900.

Source	Free Person of Color	Slaves in households	White	Mulatto	Total households	Total population
1807 Tax households	1	2	6	n/a	7	
1809 Tax households	3	4	8	n/a	11	
1810 census households	1	n/a	17	n/a	18	88
1813 Tax households	5	3	4	n/a	9	
1816 Tax households	9	21	21	n/a	30	
1820 census households	7	n/a	21	n/a	28	155
1822 Tax households	9	19	15	n/a	24	
1827 Tax households	6	n/a	8	n/a	14	
1830 census households	4	n/a	18	n/a	22	131 (Seaford had 417)
1833 Tax households	6	20	32	n/a	37	
1836 Tax households	3	11	30	n/a	33	
1840 census households	13	n/a	34	1	47	444
1840 Tax households	5	14	36	n/a	41	

Table 4: Population analysis of Middleford from 1807-1900.

Source	Free Person of Color	Slaves in households	White	Mulatto	Total households	Total population
1844 Tax households	1	23	28	n/a	29	
1848 Tax households (partial)	n/a	n/a	6	n/a	6 (partial)	
1850 census (all)	47	21	142	11	42	221
1860 census (all)	67	42	177	27	44	313
1878-80 Tax households	9	n/a	19	7	35	
1880 census	29	n/a	86	28	26	143
1900 census	7	n/a	40	10	12	57

Almost 100% of the people living in Middleford by 1850 were born in Delaware as observed in the 1850-1880 Federal Population Censuses. Previous censuses did not list place of origin, and cannot be used for comparative data. However, records do indicate that a very few of the earlier Middleford residents were from Maryland, such as John Ellegood (Allegood). From 1805 to 1900, only 11 people out of the total of 886 in the Middleford community were from outside Delaware; eight were from Maryland, and one each from Virginia, North Carolina, and Ireland.

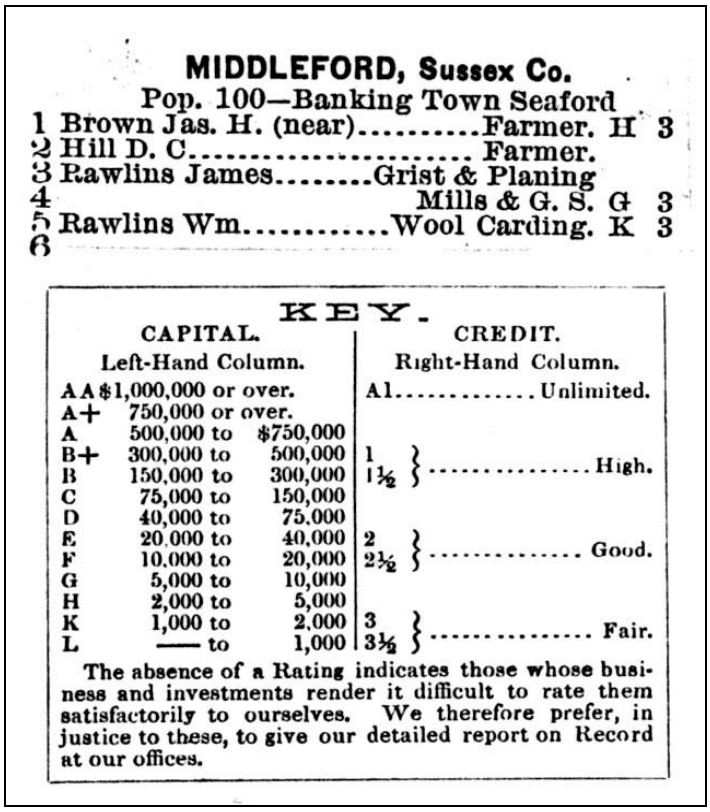
Determining the exact number of residents in Middleford at any given time was problematic. Federal Population Censuses did not list detailed information on the populace until 1850. Therefore, residents listed as being from Middleford in 1850 were traced back into the previous censuses for data compilation. The state tax assessment records provided very detailed information on slaves, including names, ages, and values, but only gave names of heads of each household not family members. The Middleford Post Office address was used for 278 people as an address in the 1860 Federal Population Census, but when the local outlying farms and slaves were added, the total population was calculated to be 313 (Leonard n.d.:134-135). Down from a population of 444 in 1840, Middleford was starting a long decline in population. A rebound of population by 1860 indicate the mills were up and running, but that was not enough to keep the momentum of the growth of the town intact (Table 4). The number of houses in town illustrated on plat maps increased slightly because the placement of structures on maps was not contingent on paying for the promotion of the lots, but the total number of residents was on the decline.

A few of the censuses stated "Middleford" in the margins or in the page header, providing the number of people considered to be a part of the community, but many of those listed as "Middleford" residents may have been farmers in the local region, using the local post office, giving rise to the discrepancies in Table 4 between the post office figures of 1840 and 1860 and the census records. For example, the Jacob Kinder Senior family did not actually live in the town limits of Middleford, but lived nearby by for many years (Kinder 1978:15-16). They appear in the tax and census records as being in or near Middleford and were included for comparative analysis. Jacob Kinder Senior was the grandson of immigrants from Holland, who first settled in Pennsylvania and

moved to the Deep Creek Furnace area by the 1760s, when Jonathan Vaughan built the first forge (Kinder 1978:15).

The history of Middleford also contained a story of "local boy does good" in the story of the rise Lot Rawlins. A descendant of Lot Rawlins (Lot's son James' grandson), Dr. John C. Rawlins of Seaford, Delaware, has been instrumental in gathering personal information of the Rawlins line. Lot's father, Charles Rawlins, was born in England in 1749 (personal conversation with Dr. John Rawlins, October 5, 2001). He came to the New World in the late 18th century and he and wife had six children. Lot served for a short time in the Delaware Militia during the War of 1812 (Rollins 1985:286). Lot's siblings all moved to the Georgetown, Kentucky region around 1810, where many of the next generation attended Georgetown College, becoming physicians. It is not known if Lot went to Kentucky, if even for a short period of time.

Lot purchased his first lot in the twelve-year-old town of Middleford in 1817, when he was 30 years old, starting with only $50 (Rollins 1985:286). His occupation for the first 25-30 years is unclear, but by the 1840s, he had become a prosperous merchant and businessman. He was able to buy many of the town lots and mills in 1846. Lot married Eliza Twiford (Twyford). After she died, he married Ann Brown, who died in 1846. Lot married a third time, to Mrs. Mary A James, who survived him (Rollins 1985:286). Lot had seven children: Mary Ann, William, John Morgan, James, Charles A., Thomas, and Phillip Henry. Lot adopted his grandson Henry White Baker, the only child of his only daughter Mary Ann, and raised him as his own child (Rollins 1985:287). By the time of Lot's death, he owned over 2000 acres and most of Middleford and the Merchant Mills, located at the head of the tidewater of the Nanticoke River. He was a very kind and eccentric man, noted for a singular impediment of speech (Rollins 1985:287). Lot never used tobacco, drank no alcohol, and never wore a pair of boots. John M. and James Rawlins took over the milling business by Lot's death in 1861 and operated it until the early 1900s (Figure 34). The Rawlins family also donated land in Middleford for the use of a park (personal conversation with Dr. John C. Rawlins, October 5, 2001).



MIDDLEFORD, Sussex Co.

Pop. 100—Banking Town Seaford

1 Brown Jas. H. (near).....Farmer. H 3
2 Hill D. C..... Farmer.
3 Rawlins James.....Grist & Planing
4 Mills & G. S. G 3
5 Rawlins Wm.....Wool Carding. K 3
6

KEY.

CAPITAL. Left-Hand Column.			CREDIT. Right-Hand Column.	
AA	$1,000,000 or over.		A1	Unlimited.
A+	750,000 or over.			
A	500,000 to	$750,000		
B+	300,000 to	500,000	1, 1½	High.
B	150,000 to	300,000		
C	75,000 to	150,000		
D	40,000 to	75,000		
E	20,000 to	40,000	2, 2½	Good.
F	10,000 to	20,000		
G	5,000 to	10,000		
H	2,000 to	5,000		
K	1,000 to	2,000	3, 3½	Fair.
L	—— to	1,000		

The absence of a Rating indicates those whose business and investments render it difficult to rate them satisfactorily to ourselves. We therefore prefer, in justice to these, to give our detailed report on Record at our offices.

Figure 34: Flyer from the Mercantile Agency of RG Dun & Co. in Philadelphia, Pennsylvania on November 11, 1880, providing a list of merchants, traders, etc. in Middleford.

James Rawlins, Lot's son, lived in the house that is currently the second house south of the intersection of Old Furnace and Middleford roads on the west side of the highway (Figure 35). The foundation was constructed with hewn logs and twigs in the plaster/mortar (personal communication with Dr. John C. Rawlins on October 5, 2001).

Figure 35: House formerly belonging to James Rawlins, Lot's son.

The African American community of Middleford

An increasing number of free person of color individuals and families lived in the Northwest Fork Hundred region of Delaware prior to the establishment of Middleford in 1805. John Parsons and Jacob Price, a "Mollater" man, were the only two free African Americans listed for Northwest Fork Hundred around 1780 (DPA 2001a:6). In 1790, Beavons on Cannon, Jacob of James Brown, Jack of William Brown, Jack Clows, and Jack Roach were listed as free African Americans of the same hundred (DPA 2001a:14). By 1800, 25 free blacks were listed in Northwest Fork Hundred, including two females (DPA 2001b:45-46). However, the records do not include details that would place any of these individuals in the pre-Middleford community.

Daniel Oney, a free person of color, was the first person to be directly associated with the town of Middleford, purchasing the first lot there in 1806. Oney lived in Middleford at least into the 1840s, but was not listed on the 1850 census for the state, presumably having died by then. It is not known if Mr. Oney was a former slave. Another free person of color, Ephraim Oney, lived in Middleford from at least 1830 to the 1850s, and is presumed to be related to Daniel. In the 1830 Federal Population Census, Daniel Oney had five free persons of color in his house and Ephraim had four. Ephraim died in 1855 and Lot Rawlins, the Administrator of his estate found no goods or chattels or debt in his name (SCPR for Ephraim Oney 1855).

The Middleford community may have been developing into a small haven for free Blacks in the first half of the 19th century. Consistently from 1810 to 1860, Middleford had a higher than state average of free African Americans. From 1810 to 1840, free persons of color comprised between 25 to 39 % of the total population of Middleford, with slaves only comprising 6 to 15 % of the total town population. The Delaware state ratio for free Blacks in 1850 was 19.7 %, compared to 38% in Middleford, however, the state ratio of slaves to the total population was 2.1% compared to 9% in Middleford. The ratio of males versus females in both the slave and free Black populations was relatively equal. The free white population was fairly evenly distributed between each gender, comprising between 53 to 66 % of the total local population during the antebellum period. The Middleford community consisted of 39% free persons of color compared to the state average of 17.8% for the year 1820 (Bureau of the Census 1909:82). The village also contained 8% slaves compared to the state average of 6.2% for the same year. As a whole, in 1820, Delaware's slave population was 4,509, half that of the total for the state in 1790, and by 1860, the number was 1,798 (Bureau of the Census 1909:133). The trend indicated Delaware's shift away from a slave based economy to free labor.

Table 5: Population statistics for Middleford from 1810 to 1840.

Year	Free white males	Free white females	Free black, mulatto males	Free black, mulatto females	Black male slaves	Black female slaves	Total population
1810	29 (33%)	19 (22%)	27 (31%) both genders		13 all (15%) both genders		88
1820	40 (26%)	42 (27%)	26 (17%)	35 (22%)	5 (3%)	7 (5%)	155
1830	40 (31%)	46 (35%)	18 (14%)	15 (11%)	5 (4%)	7 (5%)	131
1840	154 (35%)	129 (29%)	66 (15%)	67 (15%)	19 (4%)	9 (2%)	444
1850	83 (38%)	59 (27%)	30 (14%)	53 (24%)	14 (6%)	7 (3%)	221
1860	90 (28%)	87 (28%)	52 (16%)	42 (12%)	23 (7%)	19 (6%)	313
1880	44 (31%)	42 (30%)	31 (21%)	26 (18%)	n/a	n/a	143
1900	21 (36%)	19 (34%)	11 (19%)	6 (11%)	n/a	n/a	57

Records indicate former slaves that were manumitted in the region stayed in the area after being freed. Some slaves had some means of financial support, perhaps from performing work for hire to nearby landowners or businessmen. Isaac Green, a slave of Sally Moore (widow of George Moore) purchased his freedom for and undisclosed amount and was freed in Middleford under the direction of William and James Huffington on September 26, 1807 (SCDB AG30:334-335). Green was then allowed to "act and transact business as is customary for free men to do in all lawful leases". Isaac Green then purchased a 20-year-old woman named Pacy from Elizabeth Laurence, who made the transaction on behalf of Richard Laurence (probably her husband) on October 9, 1809 for 50 pounds (SCDB AG30:334-335). Although the transaction only lists an

exchange of money, no terminology regarding her freedom was in the document. Apparently, Isaac granted her freedom. It is probable that Isaac was married to Pacy.

Isaac Green appeared in the Sussex County tax assessments in 1809 and 1813, having just a horse by the latter assessment, and was listed on the 1810 and 1820 Federal Population Census. In 1810, Isaac had only one other female free person of color living with him, probably Pacy. In 1820, he had one male between 1-14 years old, one female between 1-14 years old, two females between 14-26 years old, and one female between 26-45 years old (probably Pacy), all of which were free persons of color. After 1820, Isaac Green disappeared from the archival record in the Middleford area.

Many slave owners apparently grappled with the moral dilemma of owning slaves, leading to the release of many slaves by manumission when the owner was still alive, but mainly after the death of the owner. Delaware had a strong manumission movement, a result of the combination of certain political, religious, and economic forces (Williams 1996:xii). The terminology of contemporary manumission papers reflected the mood of many businessmen. Isaac Short, another Middleford lot owner, released a slave named Hector in 1807:

> *Manumission Negro Hector from Isaac Short, Sussex County, State of Delaware: Know all men by these presents that I Isaac Short of the County and State aforesaid being Conscious to myself that the holding my fellow men in perpetual slavery is contrary to the laws of God and the unalienable right of mankind therefore for these Good Causes and Weighty Considerations of the said Isaac Short for myself, heirs, and assigns forever, doth hereby discharge and let free my Negro Man Hector ...*(SCDB AC26:202-203).

Another slave owner stated that enslaving his fellow man was contrary to "every principal of the late Glorious Revolution that has taken place in America…" (SCDB AC26:203). Some slaves were giving "contracts" similar to indentured servants in the 17th and 18th century. After time served, they could be granted their freedom. William Huffington purchased Stephen Dredden from Ephraim Tull for a period of five years and then he was to be released. However, Huffington died and his brother Edward and father William Senior released Dredden after "faithfully" serving his five years (SCDB AK33:132). The Isaac Dredden household, a mulatto family represented in the 1880, could be descendants

Still, some Middleford residents retained slaves, even though many neighbors were granting them their freedom. In the 1809 Sussex County Tax Assessment for Northwest Fork Hundred, William Huffington, Jr., the main owner of the Middleford Mills, was listed as owning:

- a Negro named Linus aged 40 ($80),
- Anthony aged 16 ($80),
- Tura aged 17 ($60),
- 5 acres of ground improved in Middleford,
- 55 acres ($1 acre for $52),

- 2 horses ($100),
- 2 yoke and oxen (($60),
- 2 cows and calves ($14),
- 1 sow and pigs ($3), and
- 61 silver plates ($67).

In the 1813 Sussex County Tax Assessment for Northwest Fork Hundred, William Dulaney Jr. was listed as owning:

- 1 Negro woman named Rose aged 35 ($60),
- 1 minor girl aged 11 ($30),
- 1 minor boy aged 9 ($30),
- 2 horses ($100),
- 1 cow and calf ($8),
- 1 yearling (4$),
- 7 shoats ($4), and
- 1 yoke of steers ($30) (1813 Northwest Fork Hundred, Sussex County, Tax Assessment)

The African Americans that resided in Middleford from 1807 to the Civil War, and to 1900 in the community had a variety of occupations. There was a blacksmith, bricklayer, cook, and some coopers (2), as well as day laborers (5), farm laborers (8), a farmer, those keeping house 3), mariners (6), servants (14), a woodcutter, and a teamster. People listed as mulatto for the same time period had the following occupations: cook (1), farm laborer (2), farmer (4), lumber mill worker (1), keeping house (6), mariners (3), sawyer (1), servant (1), and woodcutter (1). Free persons of color, like most people, tended to settle where they could find the best work. In Sussex County, the best place for work was in the smaller, rural communities, compared to New Castle County, where a higher percentage lived in the cities (Williams 1996:186). What made African Americans stay in the community after they were released from slavery? Some family members may have still been in bondage nearby. Some people may have not had enough money to move. Other people may have had a good job and did not want to leave. One of the oldest residents, Rachel Turner, who was listed in the 1880 Federal Population Census for Middleford as a 114-year-old African American, was born in 1766.

Elijah Collins, a cooper, lived in Middleford in the 1840s, and his son Jeremiah was a mariner (Federal Population Census 1850). The elder Collins was a free person of color, and moved to Seaford where he died in the mid-1850s. A sale bill posted by the Orphans Court in 1854 ensured that the public was aware of his race for the purposes of the transaction (Figure 36; SCOC Case File for Elijah Collins 1854). The bill also indicated that James Stuart, a son of either William or Michael Stuart, was the court clerk for Sussex County.

Orphans' Court Sale.

By Virtue of an Order of the Orphans' Court,
For Sussex County, in the State of Delaware,
Will be exposed to Sale, at Public Auction,

On Friday, the 26th of January,

next, at 2 o'clock, P. M., at the Union Hotel of Thomas W. Dawson, in Seaford, North-West Fork Hundred and County aforesaid,

A HOUSE AND LOT,

Situated in the Village of Seaford, in North-West Fork Hundred and County aforesaid, adjoining lands of Capt. Benjamin Stockley and others, containing, 17 and 76.100 perches, more or less, with the improvements and appurtenances; being the real estate of ELIJAH COLLINS, (negro,) deceased.

And it is Ordered by the Court, That the purchaser or purchasers be and appear at the next Orphans' Court, of Sussex County, that the Court may assign the land and premises sold to him, her or them, on his, her or their paying the purchase money to the parties entitled to the same, or entering into recognizance before the said Court with approved surety or sureties to pay the purchase money with interst, in such manner and time as the Court shall direct.

Attendance will be given, and the terms of sale made known, at the time and place aforesaid, by JOHN R. McFEE, Esq., Trustee appointed by the Court to effect said sale.

By Order of the Orphans' Court,

JAMES STUART, *Clerk.*

GEORGETOWN, Dec. 29, 1854.

Figure 36: Sale Bill for Elijah Collin, "Negro" for land in Seaford; Collins was a former resident of Middleford in the 1840s (SCOC Case File for Elijah Collins 1854).

Just as Isaac Green stayed in the area after being released from slavery, so did Purnel Stuart, a former slave of the Michael Stuart, one of the owners of the Middleford Mills in the 1830s and 1840s. Purnel lived in the community as a slave from at least 1833 to the 1840s. He was first mentioned in the 1833 tax assessment as being a 10-year-old male worth $40 (SCTA 1833). Purnel's value appreciated for the Stuart's to $95 in 1840, and to $100 in 1844. Purnel was manumitted prior to 1850 and appeared in the 1850 Federal population Census as a single, free person of color, living by himself. Also, appearing in the 1860 and 1880 census, Purnel was listed as being taxed only on his person at $150 in the 1878-1880 tax records. Purnel apparently never married and disappeared from the records after 1880. Purnel assumed the name of his previous owner

when released from slavery. There were a significant number of free African Americans in the community prior to the Civil War as well as all African Americans after the war, yet it is difficult to trace these individuals through the transition from slavery to freedom. While many of the slaves retained their owners' surname after being freed, many chose other surnames (Matheson n.d.:5).

Similar to the rest of Delaware, Middleford had a separate public school for African Americans at least until the mid-1920s (Figure 37). Presently, there are several African American families living in Middleford.

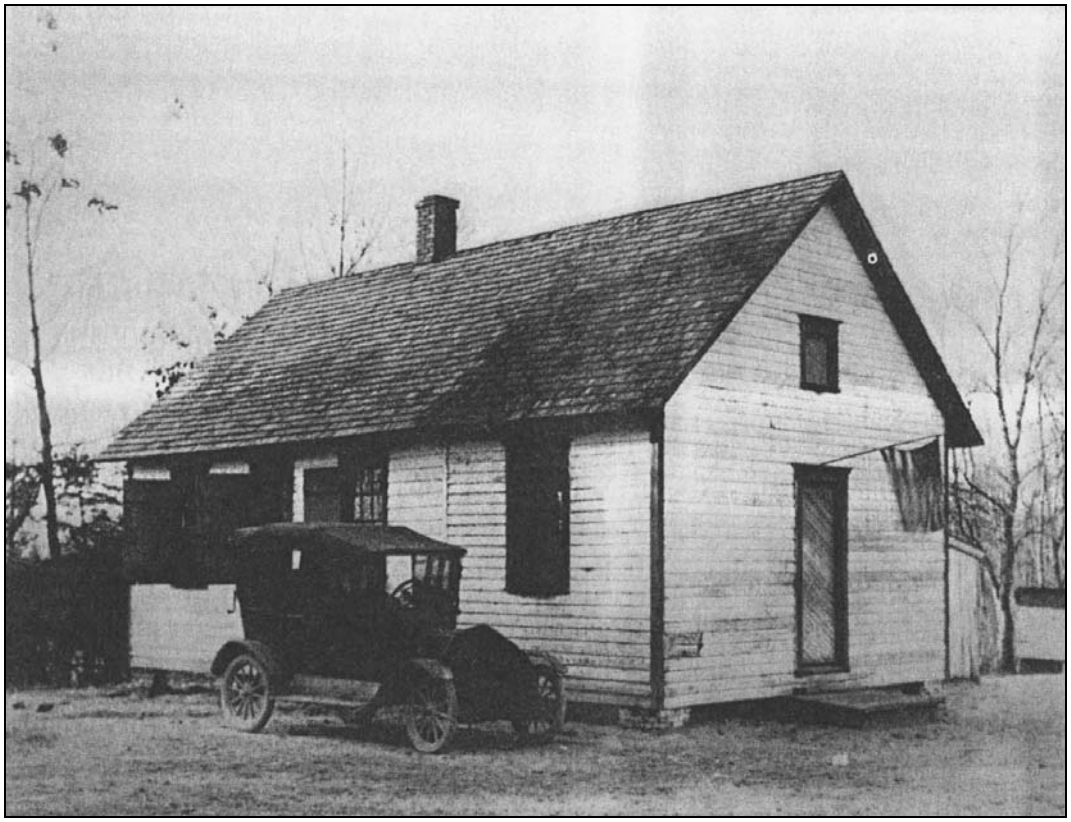


Figure 37: The Middleford School for persons of color in the mid-1920s (Skelcher 1999:70, 102).

CHAPTER 3: METHODS

INITIAL SITE RECORDING

In 1990, UDCAR archaeologist, Glen Mellin, identified Middleford Mills as an archaeological site and registered it with the trinomial designation, 7S-E-150. Mellin also recorded a prehistoric site, 7S-E-146, near Bridge 238, on the basis of a single projectile point found years previously by Sam Mellin. In 1991, a study commissioned by DelDOT determined that the structural components of Bridge 238 were not eligible for the National Register of Historic Places (P.A.C. Spero and Co. 1991). In their report, DelDOT's consultant concluded that timber bridges such as Bridge 238 were common, and that many of the features from the original construction in 1936 had been replaced.

ARCHIVAL RESEARCH

The purpose of the archival and background research for this project was twofold. The first goal was to produce a site-specific history of the Middleford Mills Archaeological District, including information about landowners, residents, structures, and activities associated with the project area from the time the property was first settled until the present. The second goal was to produce a historic context for mills and mill complexes in Delaware and the Mid-Atlantic region, so that the Middleford Mills could be compared to similar resources in the surrounding area.

The bulk of the research for the site-specific history of the Middleford Mills took place at the Delaware Public Archives in Dover. Here, Parsons researchers reviewed deeds; wills; probate records; real estate assessment records (to 1916); warrants and surveys; Chancery Court, Orphans Court, Superior Court, and Court of Common Pleas records and cases; insurance company records, industrial censuses, and various secondary source materials. Additional 20th-century deeds and real estate assessments not available at the archives were found at the Sussex County Courthouse in Georgetown. The Delaware State Historic Preservation Office in Dover provided archaeological and historical site files, historic maps, and other secondary source materials. At the Delaware Department of Transportation in Dover, researchers reviewed bridge construction plans and mill-related archaeological and historical reports. Historic milling source materials were available at the Library of Congress in Washington, D.C. Parsons researchers conducted telephone and email inquiries with personnel at the Hagley Museum in Wilmington and the Seaford Historical Society in Seaford.

SURVEY AND EVALUATION

In the initial phase of fieldwork, conducted in June of 1998, Parsons excavated a total of 39 shovel tests along two transects, one on each side of the existing road. The shovel tests on each transect were spaced approximately 15 meters apart. These tests did not identify large concentrations of artifacts, but showed that more than 1 meter of fill was present under the bridge where it crossed Gravelly Run, or "Forge Run," as the

stream is referred to on some historic maps. Pedestrian survey in the bridge vicinity located a variety of furnace and mill related features, including slag and iron-ore piles, and various timbers in the water.

Subsequently, Parsons excavated five 1-m^2 units within the area of potential effects (APE), in order to expose and identify structural features that may have been related to the historic mill complex. Two units were excavated northeast of the bridge in the vicinity of timbers found near STP J4. All soil from these units was screened through ¼-inch hardware mesh cloth, and all artifacts bagged with provenience information. The units were drawn in plan and profile views.

Limited excavation was also conducted in the water in an effort to explore vertical timbers, or sheet plies, found beneath and south of the bridge. A 1-x-2 m unit was placed beneath the bridge over sheet pilings noted in the stream channel, while two 1-m^2 units were excavated in association with a line of sheet pilings south of the bridge, one unit near each bank where the pilings approached the shoreline. Stratigraphic information was limited due to problems with stream current in the channel or silt build-up, resulting in low visibility, in the slackwater near the shoreline south of the bridge. Excavated deposits were wet screened through ¼-inch mesh hardware cloth, and artifacts were bagged with available provenience information. Plan and profile data were recorded with measured sketches.

MAPPING

As noted earlier, Bridge 238 lies near the southeastern edge of the Middleford Mills complex. In order to properly assess whether features in the project APE might contribute to the eligibility of the complex as a National Register archaeological district, Parsons prepared a scaled map of the area using a Global Positioning Satellite (GPS) system (Figure 38). This provided accurate locational data for known mill features on the landscape, and provided additional geographic context for the archaeological elements in the project area. The GPS data were incorporated into a Geographic Information System (GIS) database, that facilitated watershed analysis upstream from the complex and reconstruction of the mill pond at various periods in the past.

MITIGATION AND ARCHAEOLOGICAL DATA RECOVERY

In considering possible fieldwork alternatives following the1998 survey, it was decided that testing in the roadway or alongside the road would likely yield little data. The survey had indicated that the fill used to build up the current road surface was too deep for efficient excavation by typical archaeological methods, while those resources that had been positively identified lay in the water below the bridge span. The best approach to further investigation was to allow the bridge replacement contractor to remove the existing bridge, as per the construction contract. The excavation of road fill

Label	Description
Q	Wharf
Q	Wharf
Q	Wharf
H	Wood Features (tracks)
B	Race
E	Wood Feature (Water control)
D	Wood Feature (Water control)
N	Site 7S-E-19
I	Slag Pile
I	Slag Pile
P	Wood Foundation (gates?)
O	Wood Foundation (gates?)
A	18th-century dam
B	Race
C	Iron Ore Quarry
F	Bridge 238
G	Iron Ore Quarry
J	Middle Gates
B	Race
L	Sawmill
K	Gristmill
M	Slag Pile, 18th-century Forge Site?

Figure 38: Middleford Mills Archaeological District

would be monitored by an archaeologist and halted when early deposits below the fill were encountered. In addition, the contractor would erect a cofferdam around the site, also as per the contruction contract, to provide a dry environment for construction of the replacement bridge. This area would include the locations in which mill-related remains had been identified in the stream channel, and where more such remains were anticipated. At this point, a break in construction would be scheduled to allow the remaining archaeological work to be completed. The work was thus scheduled and conducted in July 1999.

The cofferdam that was installed measured approximately 36 x 70 feet. The metal sheeting consisted of interlocking, corrugated iron pilings that were driven an average 20 feet into the ground by a crane and vibrator. The stream was diverted through a 48-inch diameter metal culvert (Figure 39), supported by chains suspended from 12-inch steel beams driven vertically into the streambed on 5-foot centers. Suspension of the diversion culvert allowed archaeological excavation near and beneath the stream channel.

Archaeological work began with monitoring of excavation of the 1936 bridge fill. No articulated mill-related remains were found in the bridge fill above the high water mark during removal of the existing bridge and supports.

With the cofferdam in place and pumped dry, archaeological excavation proceeded. The remaining fill and recent stream deposits were excavated using a small backhoe lowered into the cofferdam. Because of the horizontal extent of the site, individual hand-excavated units were not practical, but mill-related features were exposed by hand. No concentrated deposits of historical artifacts were identified during the excavations. Screening of sediments was not considered necessary given the absence of artifacts other than 20th-century debris washed in by the stream. Thus, all of the archaeological information of relevance to evaluating the resource consisted of architectural remains. Scattered artifacts were recovered during feature excavation, and as a control, samples of backdirt were carefully trowel-sorted at ground level, above the cofferdam walls.

Figure 39: Mini Excavator in the Cofferdam.

CHAPTER 4: FINDINGS

SURVEY AND TESTING SUMMARY

Fieldwork during the survey and testing parts of the investigation consisted of four elements, two on land and two in the streambed of Gravelly Run. The land elements consisted of: 1) the mapping of existing surface features within the proposed right-of-way; and 2) the excavation of 39 shovel tests on the north and south sides of the modern road, and the excavation of two 1 m^2 test units on the northeast bank of the bridge abutment. The underwater elements consisted of: 1) the survey and mapping of features in the streambed to the north and south of the bridge, as well as beneath the bridge span; and 2) the excavation of test units in the streambed in association with features recorded there. Finally, a sketch map was completed of the mill complex north of the road, including the 18th century dam, related race structures, the 19th century dam, and several quarry and borrow pits.

Shovel Tests

The purpose of shovel testing was to determine the character and extent of the fill associated with the berm supporting S 46: how much of the material was the result of modern road construction; how much, if anything, remained of the original dam fill; and whether there were deposits that might indicate the potential for mill related structures. Shovel tests were excavated in two transects (Figure 40). Transect A, consisting of 18 tests, was excavated on a 15 m interval along the north side of the road, between 5 and 10 m from the edge of the blacktop. Transect B, consisting of 16 tests, was excavated on the south side of the road, on a similar 15 m interval between 5 and 10 m from the edge of the blacktop. Five additional tests, referred to collectively as Transect J, were excavated on a judgmental basis in the immediate vicinity of the bridge.

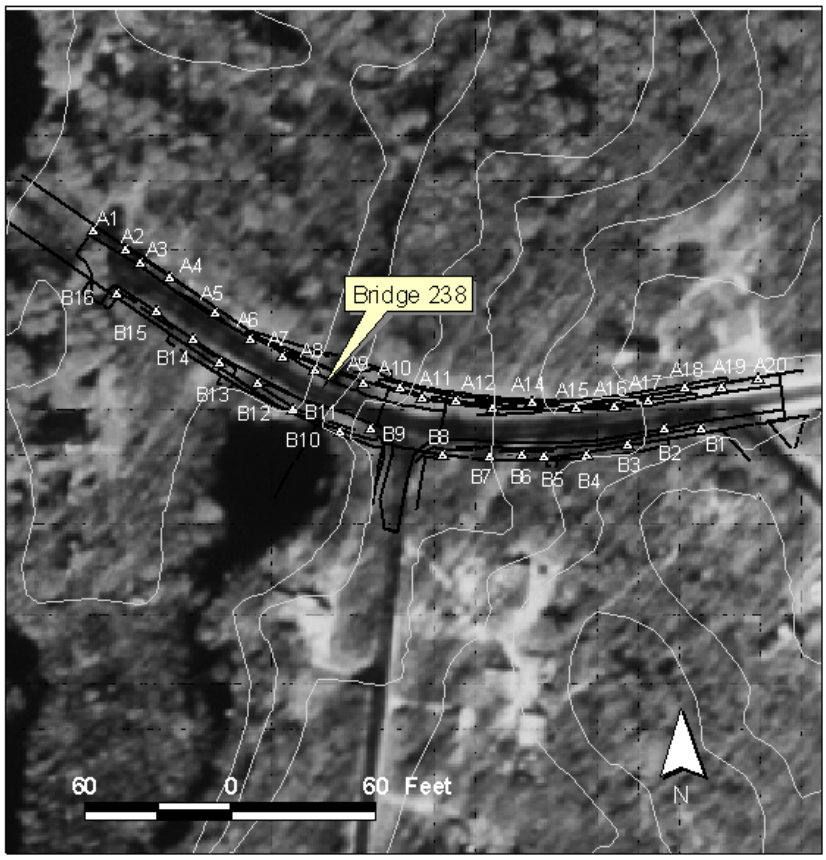


Figure 40: STP Locations

Transect A:

Most of the shovel tests on or near the berm that was constructed for the bridge showed truncated and disturbed profile sections, with fill related to the mill dam or to more recent road construction directly overlying cut subsoil. Exceptions were several tests with buried A- and B-horizons (A5 and A8, west of the bridge, and A11-13, east of the bridge). The A-horizon probably represented ground surface prior to road or dam construction. Several tests well east of the bridge bore no evidence of fill, implying that there had been little disturbance from road construction: A14, A16-18 each contained apparently intact, zonal profiles with A-, B- and C-horizons; A19-20 were in modern garden patches and contained a cultivated layer overlying subsoil. Shovel tests A3 and A4 fell in the entrance to a private driveway, and thus were not excavated, making the total number of tests excavated on the transect 18.

Transect B:

The shovel tests farthest east of the bridge on the south side of SR46 (shovel tests B1-6), contained fill from surface to base, approximately 1 m below grade in each case. Tests B7-9, located on either side of Old Meadow Road (intersecting SR46 from the south), showed truncated or partially truncated natural profiles, with E- and B-horizons

present below varying amounts of fill. Shovel test B10, east of the bridge contained sandy fill to a depth of at least 110 cm. Shovel tests west of the bridge, B11-15, contained fill and/or redeposited sand to depths of 100-130 cm or greater. There was little indication in these excavations as to the ultimate source of the sandy fill, whether from the mill dam or more recent road improvements.

Transect J:

A series of judgmentally placed shovel tests was located near the bridge. They revealed fill that typically overlay the original alluvial deposits associated with the edge of the stream. Shovel test J1 was located on low ground southwest of the bridge abutment, and encountered fill to over 1 m. Shovel test J2 was also placed on low ground, at the base of the berm northwest of the bridge abutment. Organic-stained alluvial sand, representing the stream edge, was located 15 cm below surface. Shovel test J3 was placed on the edge of the berm northeast of the bridge abutment, where fill and redeposited topsoil were documented to at least 1.3 m below grade. Shovel test J4 as located on low ground at the base of the berm, northeast of the abutment. Fill was recorded in this test to a depth of 85 cm, followed by intact alluvium associated with the original bank of the stream. As in the shovel tests in Transect B, there was no clear evidence of the source of the fill in these excavations. Shovel test J5 was placed north of J4, on low ground beyond an erosional ditch that cut toward the northwest. Intact alluvium was recorded in this test below a thin topsoil layer.

Summary

In general, cut-and-fill profiles were recorded in areas away from the bridge. There appeared to have been more disturbance south of the road, as evidenced by deeper fill deposits, and less disturbance north of the road and at the east end of the survey area, as the road climbed slowly out of the wide stream valley. Near the bridge, fill lay over wetland deposits at the original edge of the stream. There was no direct evidence of early construction fill or structural features at any point along the portions of the right-of-way that were surveyed.

Test Units

Two contiguous 1-m^2 excavation units, Test Units 4 and 5, were excavated on the north edge of the berm (Figure 41). They were placed near the base of the slope to provide a cross section of the berm at a point where hand excavation could reach the underlying, natural deposits. The profile section showed a sloping layer of sandy fill that appeared to be associated with bridge construction, based on discarded lumber occurring in the deposit. The color, texture and depth of this deposit implied that the clean fill observed in shovel tests north and south of the road was probably related to the modern bridge, as well. The modern, sandy fill overlay additional level fills of undetermined origin that contained gravel and sandy clay. At the base of the profile, redeposited topsoil mixed with clay fill lay on top of intact alluvium, the latter representing the original bank of the stream. These lower fill layers could have been remnants of the 19th-century dam, although there was no directly corroborating data.

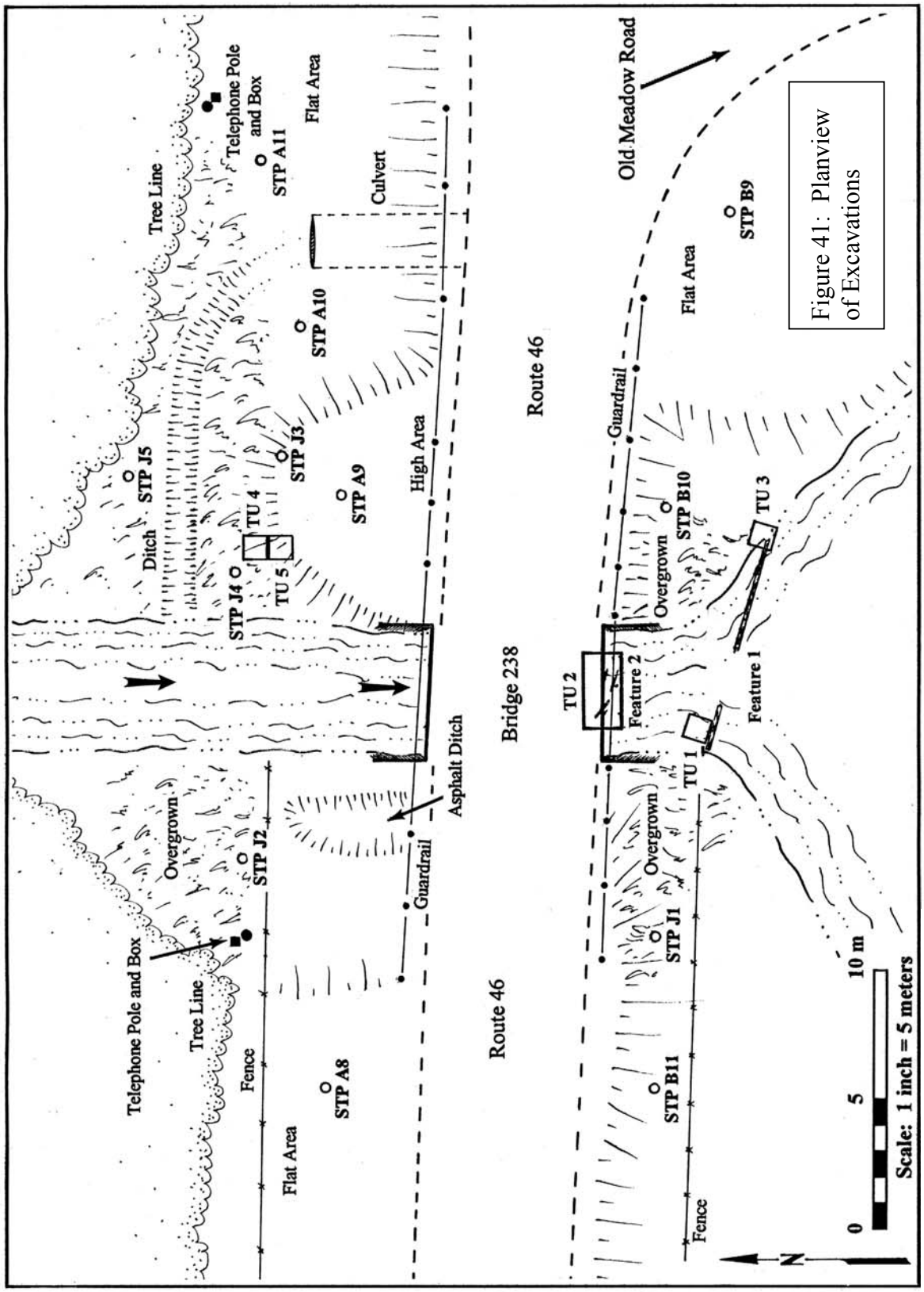


Figure 41: Planview of Excavations

Underwater Components

Pedestrian survey of the banks and channel of the stream was conducted at lowest tidal ebb. In six days of on-site activity, the maximum tide differential was measured as 2.8 feet. Due to relatively brisk currents, particularly when tidal ebb combined with the normal stream flow, silt accumulation in the stream was minimal and visibility was good. Thus, the survey included visual inspection of the streambed. In addition, a solid metal probe was used to map the hard-packed alluvial deposits forming the natural base of the stream channel, on the assumption that soft, silty deposits might signal infilled mill features, such as a wheel pit. No such features were located, although the hard sandy alluvium in the channel did give way to deep silt south of the bridge at the edge of a large quarry pit. Long-time area residents noted that the quarry pit is at least 12 feet in depth (Glen Mellin, personal communication 1998).

Three wood plank features were observed at the southern edge of the bridge. They were assigned feature numbers in order of documentation, and are described in detail in the following section of the report.

CHAPTER 5: DATA RECOVERY EXCAVATIONS

As described in the Methods section of this report, data recovery operations were conducted as a scheduled task of within the overall bridge removal process. A cofferdam was constructed around the site, and the flow of Gravelly Run was diverted into a 48-inch-diameter metal culvert (Figure 42). This produced a relatively dry environment within which to remove the fill and structural members associated with the 1936 bridge and to examine the archaeological remains of the milldam and earlier mill-related features.

The cofferdam measured approximately 36 x 70 feet, the long axis extending northeastward from the southern edge of the highway right-of-way. This edge roughly corresponded with the southern face of the milldam that was raised in the 19th century to confine the flow of the Nanticoke River and power the several mills located nearby. The archaeological investigation within the cofferdam encompassed an area that included the milldam and a portion of Gravelly Run upstream from the dam, as well as the ground extending between 15 and 20 feet on either side of the current stream channel as it flows beneath the modern road.

The modern road surface and the underlying fill was removed with a crane-operated clam shell bucket to the level of the bulkhead associated with the 1936 bridge. Additional fill was excavated behind the bulkheads to expose the heavy pinewood sheet pilings that retained the fill. The space between the sheet pilings and the edges of the cofferdam was limited, so that careful excavation with heavy equipment was impractical. Thus the sheets, and the large pine bollards that supported the pilings and cross members, were removed using a vibrating extractor, also crane-operated, that pulled the sheets and piles out individually without disturbing the surrounding ground surface. When completed, the remaining modern fill behind the bulkheads was removed with the clamshell bucket.

Excavation of the underlying fill, that was associated with earlier road berm and dam construction, was undertaken with a backhoe placed at the top of the cofferdam, at the level of the modern road. As the level of fill reached the maximum extent of the backhoe arm, several fragile wooden features became apparent near the cofferdam wall. At this point, mechanical excavation continued through the use of a mini-track hoe, that was lowered into the cofferdam by the crane. The mini-hoe was able to maneuver within the confined areas at the base of the cofferdam, between the diversion culvert and the wooden features lining the cofferdam walls. Using this combination of equipment, it was possible to excavate mechanically to the base of the cultural deposits on either side of the stream and eventually to trench across the stream channel, documenting a series of flood episodes that will be described below.

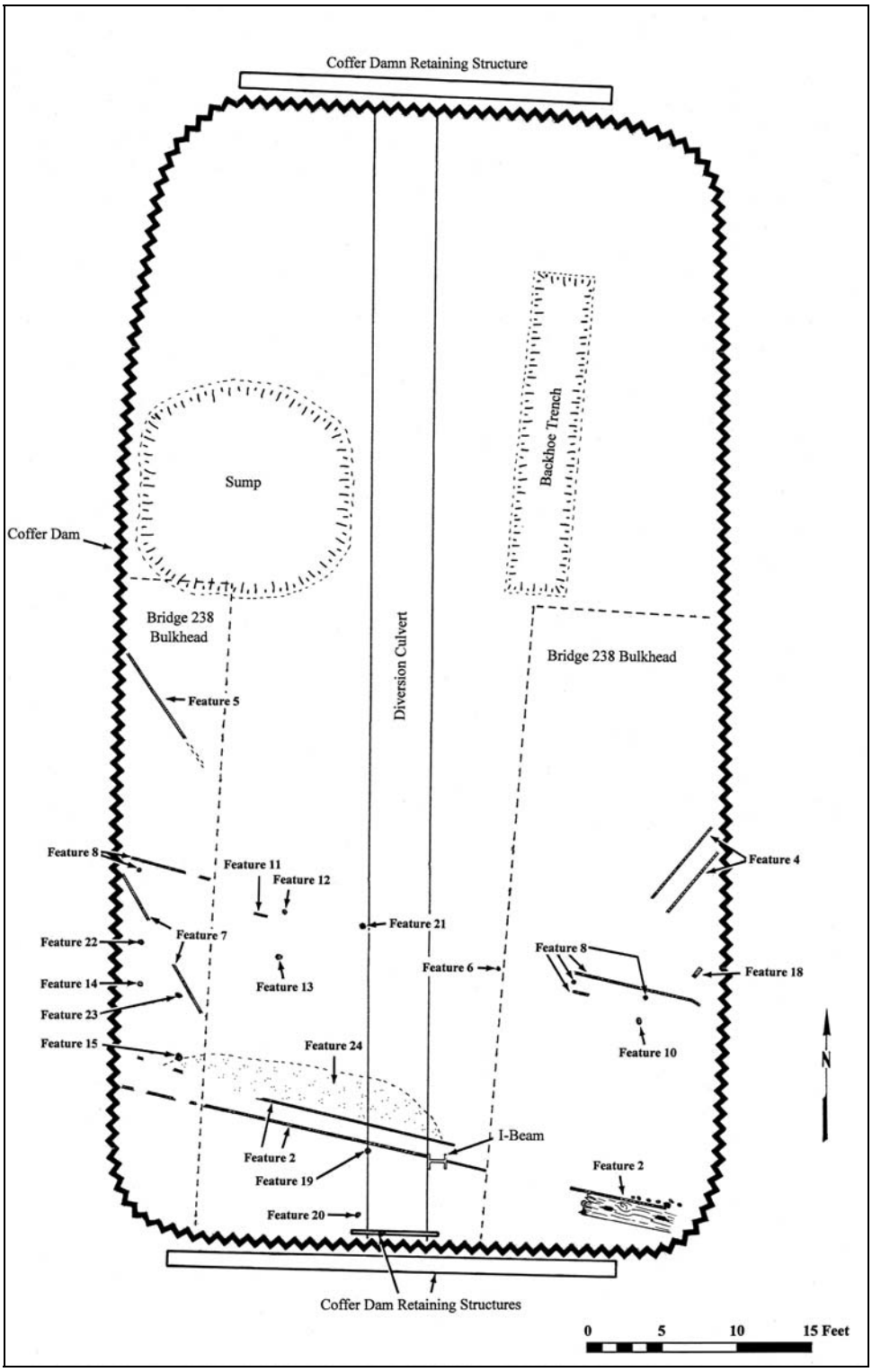


Figure 42: Planview of cofferdam

Figure 43 shows a cross section of the deposits west of the stream, at a point approximately 20 feet north of the southern edge of the cofferdam, near the center of the 1936 bridge bulkhead. The cut clearly shows the effects of historic period construction on the recent evolution of the stream channel. The extensive deposit of comparatively homogeneous, orange sand and clay fill that comprised the mass of the berm associated with the 20th century bridge lay behind the bulkhead. Lying against the cofferdam sheeting, and partially truncated by them, were the remnants of wooden features that it appears were originally associated with water control. They were first observed at depths of 8 to 10 feet below the modern road surface, along with a distinct change in the character of the surrounding fill. The fill became more compact, seen as a mixture of various patches of silty clay, sandy clay, and gravel. At the base of the fill lay a thin deposit of iron-stained and concreted sand, directly over undisturbed subsoil.

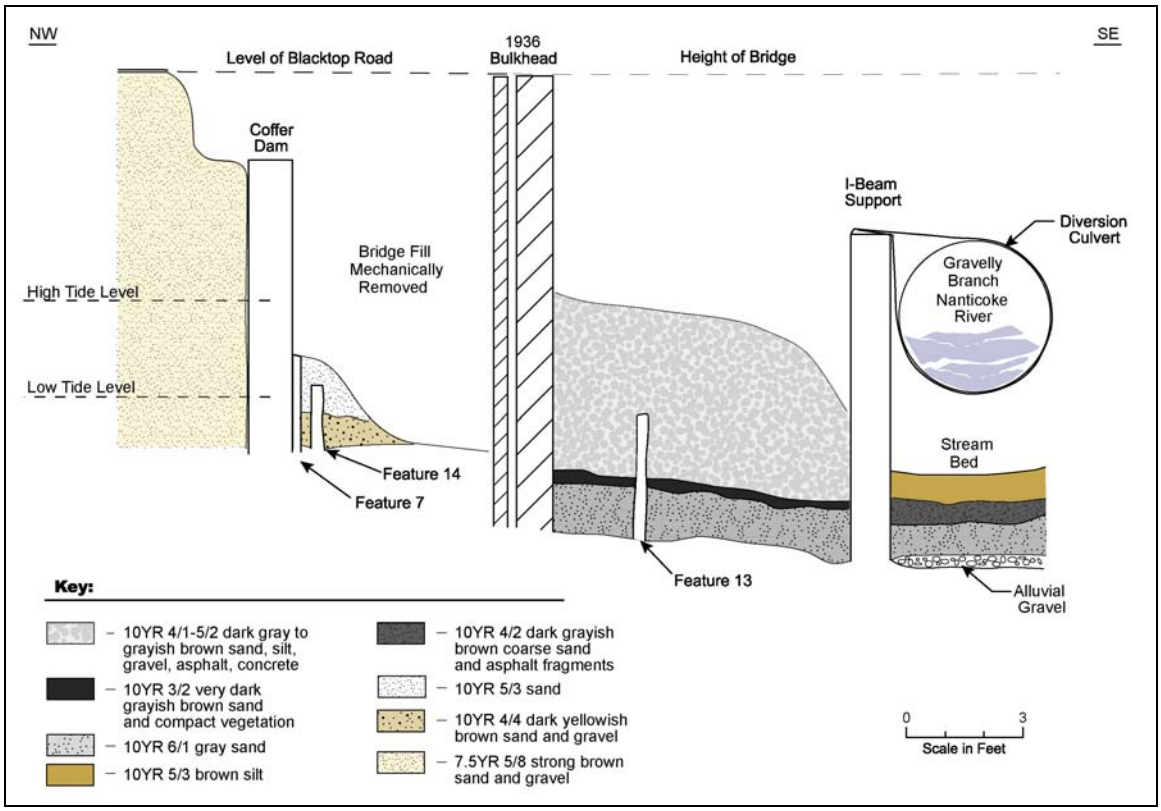


Figure 43: Stratigraphy, Stream cross-section.

To the east, between the bulkhead and the stream channel, lay mixed gray sand and silt, representing the recent floodplain of the stream. The surface of this deposit began as little as 6 feet below the top of the berm, and sloped markedly downward to the east, in the direction of the stream channel. At the base of the silt, 10 to 10.5 feet below modern grade, lay a 3-5 inch thick mat of decomposing vegetation. This material lay at the same level as the base of the stream channel, and thus probably represented tidal flats adjacent to the stream prior to dam construction, before the stream flow was constricted.

Below the vegetation lay clean, undisturbed gray sand, related to the Pleistocene sands that underlie all of the Delaware Coastal Plain.

Beneath the diversion culvert, the bed of Gravelly Branch can be seen. The uppermost layer consisted of the sand and silt that constantly washed in from the surrounding excavations, due to the influx of water from the saturated deposits and from inevitable leaks in the cofferdam. Below this recent deposit, the streambed consisted of distinct layers of gravel, mixed with brick, coal and asphalt debris, interbedded with layers of silt and clean, sorted gravel. These deposits and their implications for the development of the stream channel will be considered in more detail later.

The cross section on the east side of the stream, at a point just over 40 feet north of the cofferdam wall, immediately north of the modern bridge bulkhead was simpler. It consisted of stacked fill deposits overlying natural flats and undisturbed subsoil. The layer of organic debris seen on the west side of the stream did not occur consistently on the east side.

The sediment strata illustrated in the two cross sections typified the deposits across the entire cofferdam excavation. Briefly summarized, within the bulkheads forming the 1936 bridge lay undifferentiated fill used to support the road surface. Between the bulkheads lay silty floodplain material associated with the stream and probably laid down since its confinement by the dam. Tidal wetland deposits underlay the recent silts, cut by the present stream channel. North of the bridge bulkhead, fill deposits were somewhat more varied, suggesting less planning in the deposition, since this portion of the berm was not intended to carry the load of the modern roadway.

The material of greatest archaeological interest lay beneath the bridge fill and recent floodplain deposits, in the form of wooden features that appeared to be connected with pre-20th century water control. The remainder of the archaeological descriptions will detail these features. The features were numbered arbitrarily in the field, in order of discovery. Further analysis has shown that there is a logical order to the features that supercedes the field numbering system, and so the features are grouped for this presentation according to their apparent association. In general, the features appeared to be associated with three parallel bulkheads that extended across the width of the stream channel. A list of the groups and their constituent features follows in Table 6. A plan view of the cofferdam excavation showing the bulkheads is shown in Figure 44.

Table 6: Archaeological Features Grouped by Structural Association

Group	Features	Description
Bulkhead 1		
	Feature 1	sheet piling and supports
Bulkhead 2		

Table 6: Archaeological Features Grouped by Structural Association

Group	Features	Description
	Feature 2	sheet piling and supports
	Feature 7	wing wall sheet piling
	Feature 14	Post
	Feature 15	Post
	Feature 16	bulkhead sheet piling
	Feature 19	Post
	Feature 22	Post
	Feature 23	Post
	Feature 25	Post
	Feature 26	Post
Bulkhead 3		
	Feature 4	wing wall sheet piling and supports
	Feature 5	wing wall sheet piling and supports
	Feature 6	Post
	Feature 8	bulkhead sheet piling and supports
	Feature 9	Post
	Feature 10	Post
	Feature 11	bulkhead sheet piling
	Feature 12	Post
	Feature 17	wing wall sheet piling and supports
	Feature 21	Post
Isolated		
	Feature 3	planks associated with 1936 bulkhead
	Feature 13	Post
	Feature 18	isolated vertical plank
	Feature 20	Post
	Feature 24	cut-and-fill deposit

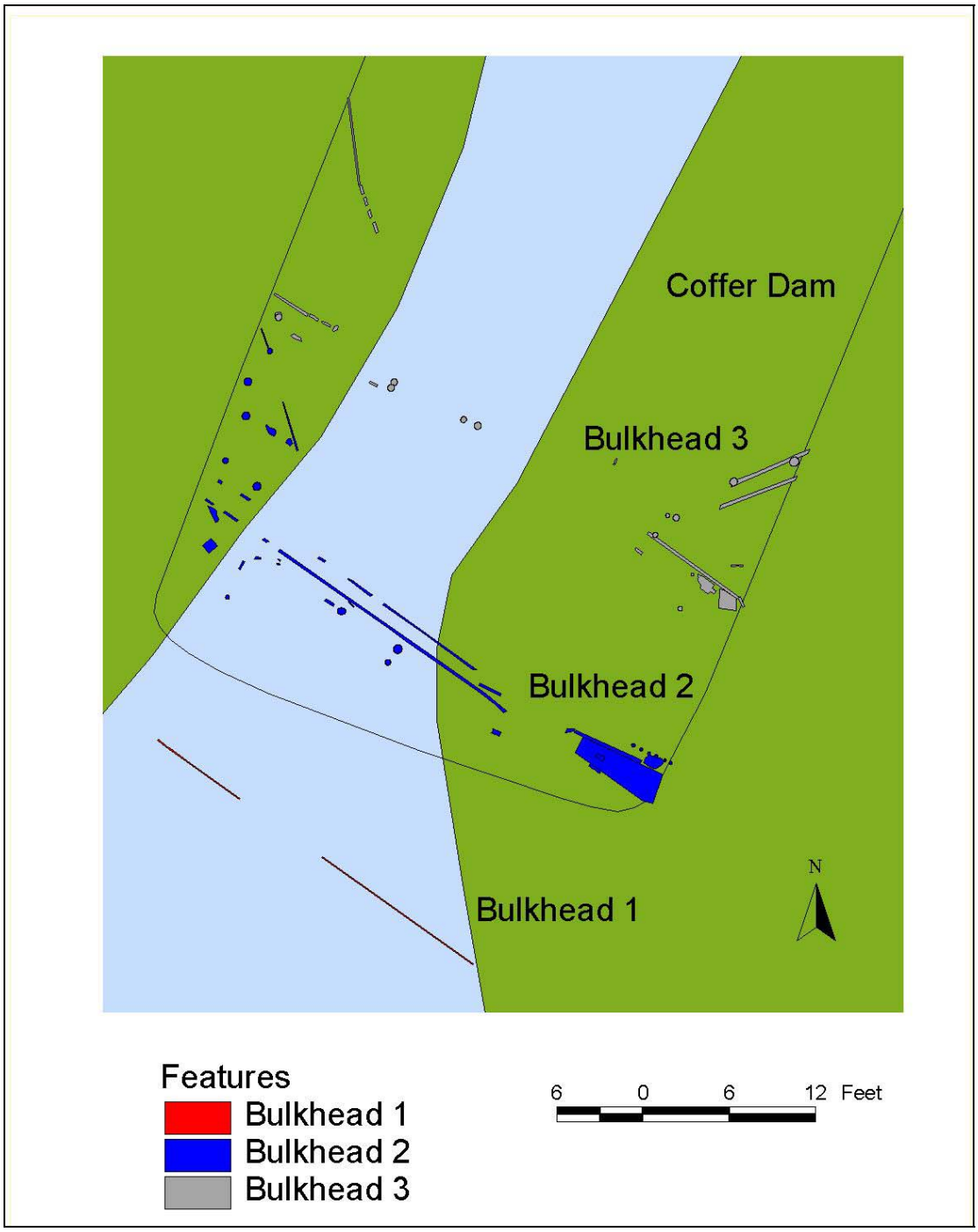


Figure 44: Planview of Bulkheads

BULKHEAD 1

Feature 1

The material comprising Bulkhead 1 lay south of, or downstream from the cofferdam, at the edge of the wide and deep ponded area thought to be a quarry pit. The

bulkhead was investigated as an underwater component of the site during the survey portion of the project. It was documented as a single feature, designated Feature 1. Due to its location outside of the cofferdam, the bulkhead was not investigated further during the data recovery phase of the project. Feature 1 consisted of a single line of 2 x 6-inch planks set vertically in the stream bottom at the edge of the basin of the quarry cut. The line of the planking ran east-west across the stream, and the planks extend from both the east and west banks. There is a gap of approximately 7.25 feet, west of the center of the line and corresponding with the main channel of the stream. At the west end, the planking extended beneath rip-rap at the base of the road berm that consisted of large chunks of macadam. Removal of several of these blocks revealed an anchoring system, comprised of a 10 x 10-inch timber set into the bank and attached to the planking on the south, or downstream side. The connecting planks consisted of several 2-ply planks of varying widths, fastened by large cut nails. The large, anchoring timber appeared to have been recycled, since there is a 5-inch-deep scarf joint cut into the wood, but no evidence, such as fasteners or holes, to indicate that additional timbers had been attached to it: the notch was weathered at the east (stream) end, and there were no other timbers extending into the stream.

There was no indication of a similar anchoring system on the east bank. No additional wood was found beyond the last plank visible at low tide. It may be that the slope of the bank here was not as steep, due to the shape of the quarry cut, and that the planking was sheltered from currents and so did not need extensive anchoring. Alternatively, the anchoring timbers may have been removed for other purposes.

Except for the anchor at the west end, the planks forming Feature 1 were free standing. They were deeply buried in the streambed; no supporting posts were observed. Nor was there evidence of posts or hardware (hinges, pintles, gudgeons, etc.) at the gap ends of the planking, such as would be expected had gates been present. There were several large, cut nails in the planks, driven through the upstream side, but no signs of any attachment.

Two test excavations, Test Units 1 and 3, were placed below the waterline to further investigate Feature 1. Both units measured 1 m^2, and both were located on the upstream side of the bulkhead, Test Unit 1 near the west end of the feature, and Test Unit 3 at the east end. Each unit contained a surface layer of recent, silty and somewhat mucky or organic alluvium, followed by clean, coarse-grained sand with small gravels extending at least 1 m in depth (the base of this deposit was not reached). Modern glass and metal artifacts, as well as earlier artifacts such as cut or wrought nails, and molded brick, were recovered from both layers in each unit.

BULKHEAD 2

Bulkhead 2 consisted of a run of low sheet piling that stretched across the channel of Gravelly Run. It was reinforced by posts, and, at the east end, by a massive timber.

Most of the feature was poorly preserved. A portion near the east wall of the cofferdam was relatively intact, and measurements there indicated that originally the bulkhead rose approximately to current mean sea level. The remnants of a wing wall were present on the western side of the bulkhead. This feature consisted of similar sheet pilings supported by several posts, intersecting the bulkhead at an oblique angle. There may have been a corresponding wall on the eastern end of the bulkhead, but if so, it lay beyond the area exposed in the cofferdam. The east end, as revealed by excavation within the dam, consisted of a grate formed by a series of small posts placed on the upstream side of a gap in the bulkhead planks. The main segments of the bulkhead, within the streambed and east of the stream, were excavated as Features 2 and 19. Portions of the sheet piling and posts west of the stream were excavated as Features 15 and 16. The wing wall was excavated as Features 7, 14, 22 and 23. The individual features are described in detail below.

Main Bulkhead
Feature 2

Feature 2 consisted of a series of sheet piles, associated posts and reinforcing timbers (Figure 45). Two segments were identified. One, located in the center of the streambed, was originally documented in the survey and testing phase of the project. That investigation took place underwater, before the cofferdam and diversion culvert were proposed, and thus several questions remained about the function and integrity of the planks and posts making up the feature (Figure 46). They were described at the time as two parallel sets of 2 x 6-inch sheet piles, separated by a space of approximately 12 inches. A 6-inch-diameter wooden post was set approximately 6 inches to the south, downstream from the sheets.

The second portion of Feature 2 lay beneath the fill of the 1936 bridge, and was exposed by mechanical and hand excavation, after the heavy posts and pilings of the bridge bulkhead were removed. The sheets consisted of pinewood boards, 2 inches thick, ranging from 8.5 to 10 inches wide, and 6.5 to 7.5 feet in length. They had been driven into the ground, rather than placed in an excavated ditch, as evidenced by both the lack of disturbance in the subsoil typically associated with a trench, and by the ends of the planks. The ends were trimmed to a point (double-bevel) relative to thickness, and finished with a single bevel relative to width (Figure 47). The pointed finish allowed the planks to be driven more easily into the clayey soil, while the single bevel acted to force each plank against the adjacent plank. As the wood became wet and swelled, pressure on the joint would have increased, producing a watertight fit[1]. There was no evidence of the type of damage, or mushrooming at the upper ends of the boards that would be expected from driving them deeply into the subsoil, suggesting that the planks had then been driven in and then cut cleanly at a specific level. As noted above, the level at which they had been cut appeared to correspond with current mean sea level.

[1] this same technique was used for the sheet piles comprising the 1936 bridge bulkhead.

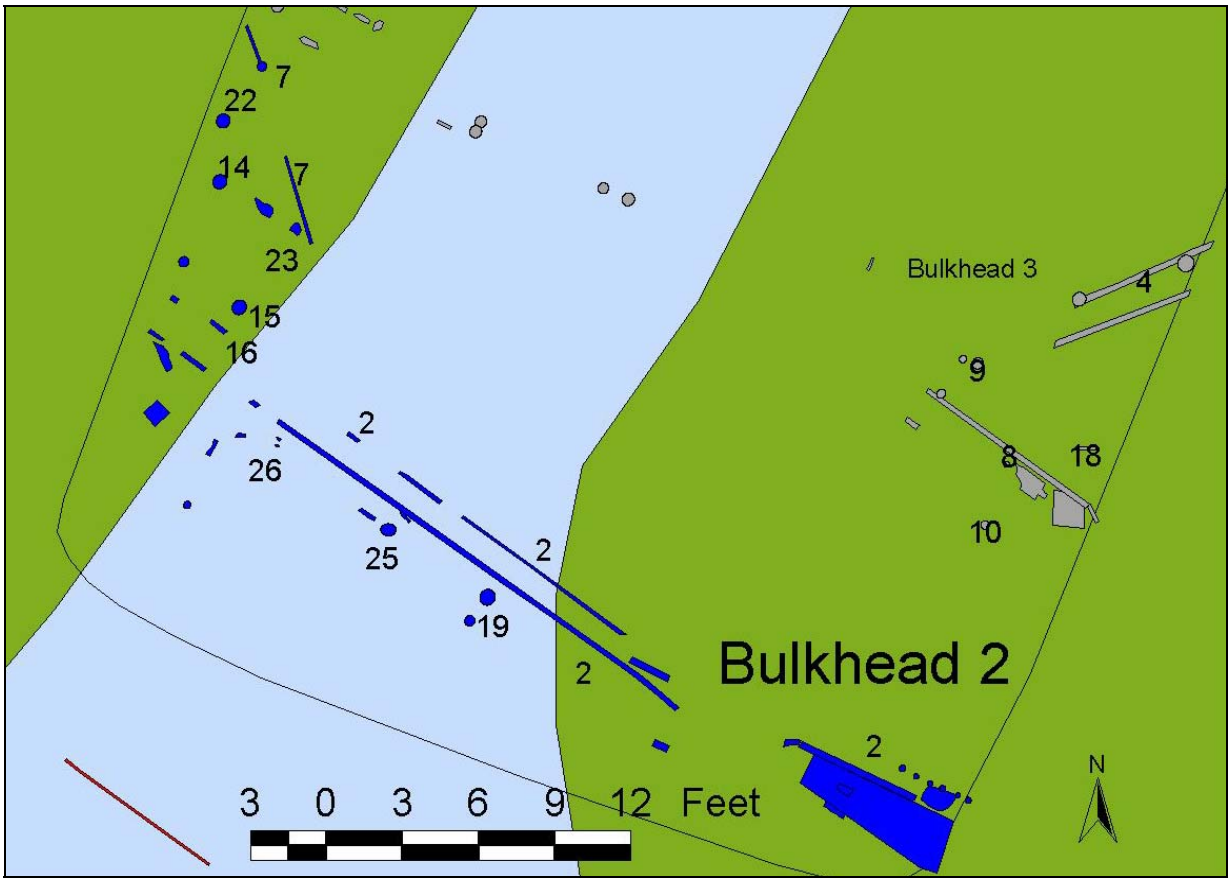


Figure 45: Planview Bulkhead 2.

Figure 46: Central portion of Feature 2, underneath the diversion culvert. Facing Southeast.

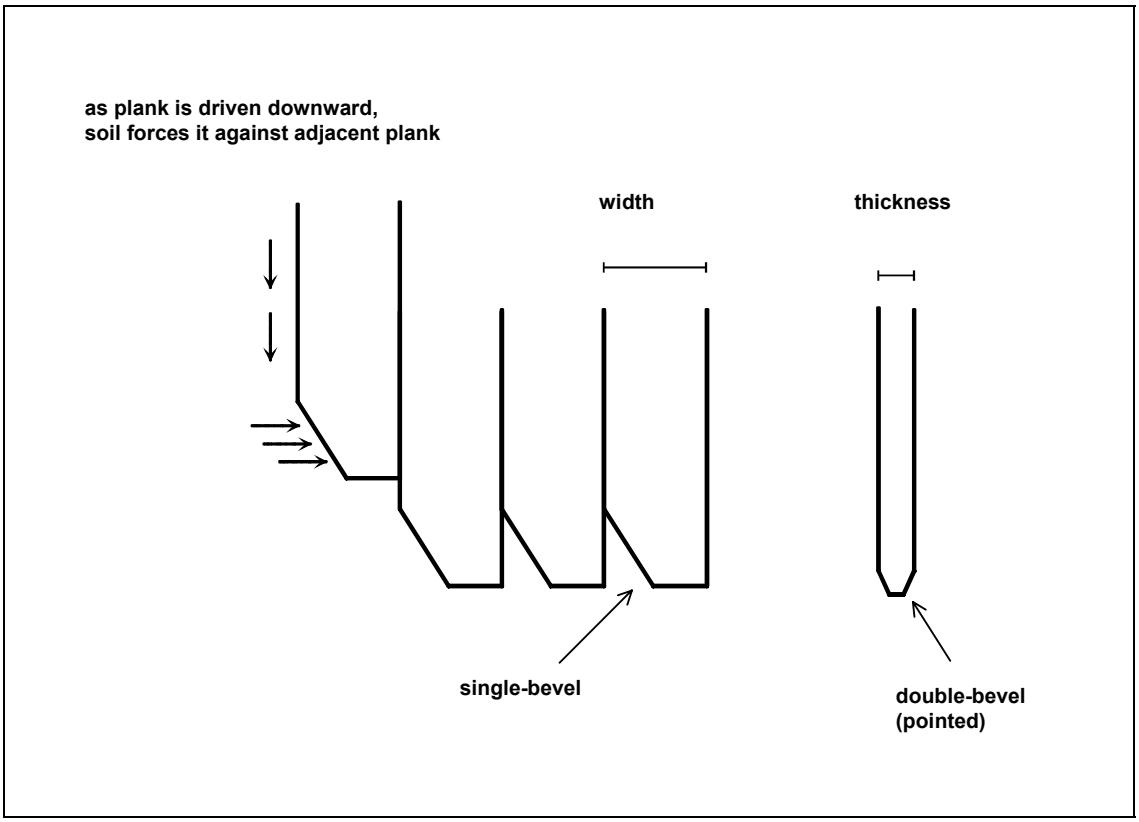


Figure 47. Schematic Diagram of Sheet Piling Installation.

Figure 48: East End, Bulkhead 2, Feature 2, Crash Rack. Facing South

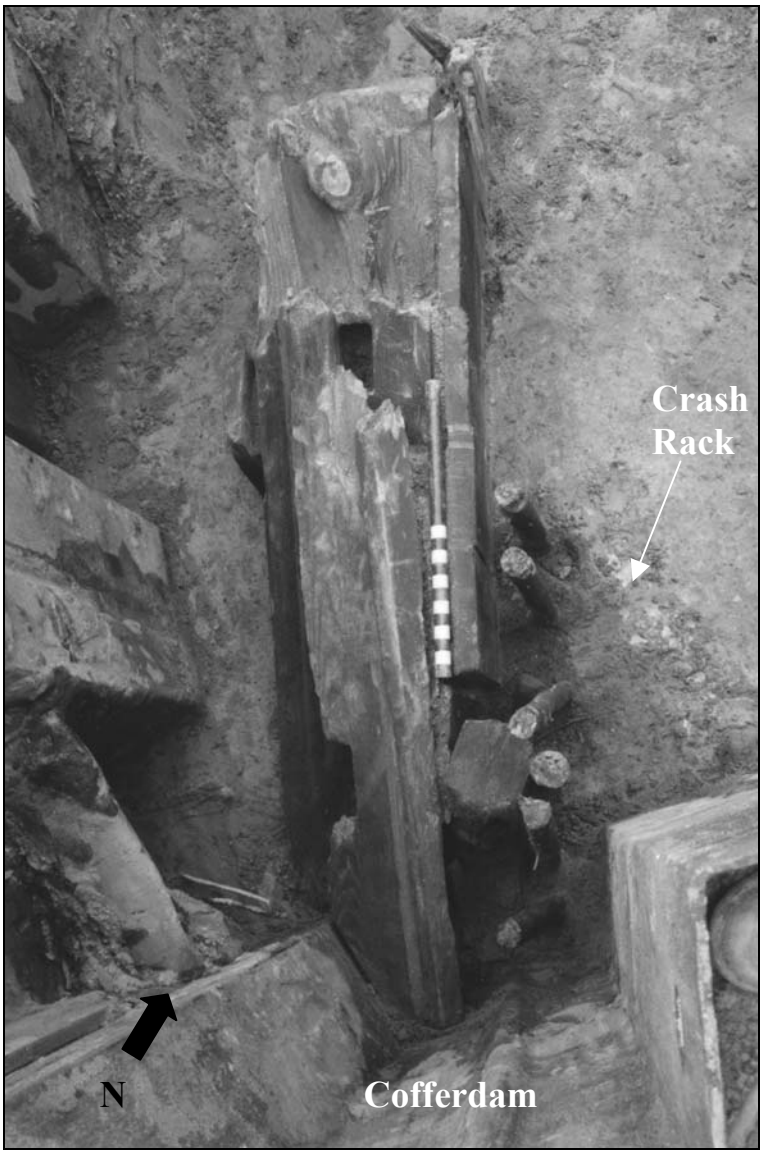


Figure 49: Overhead view of Bulkhead 2, Feature 2 and Crash Rack

At the east end, the bulkhead consisted of a single line of sheet piles, reinforced with posts and a heavy timber. Only one of the posts remained. It consisted of pinewood, measuring 4.5 inches in diameter, and it had been driven into the sandy clay subsoil and cut level to support a large timber. The timber measured 13 x 15 inches in cross section. It lay horizontally at the level of the top of the sheets and was at least 5 feet in length (the east end was truncated by the heavy metal sheets of the cofferdam, which had knocked the timber askew as they were driven in). There was no evidence of additional timbers to the west (toward the channel), but the bulkhead was cut at about that point by the pilings of the 1936 bridge. There was no evidence of fasteners securing the timber to the post, and thus may have been held in place by its own weight and the pressure of the surrounding soil. The spacing of the posts could not be determined, since

only one remained in the excavation area. In addition to the post, a single vertical plank was located on the downstream side of the bulkhead. This plank bore similar measurements to those forming the face of the bulkhead. There was no evidence, such as molds or soil stains, to suggest that additional planks had been present forming a second line of sheet piles. And thus it was assumed that the plank was non-structural, perhaps serving as an aid to aligning the bulkhead timbers during construction. Figure 50 shows a reconstructed cross section of the bulkhead.

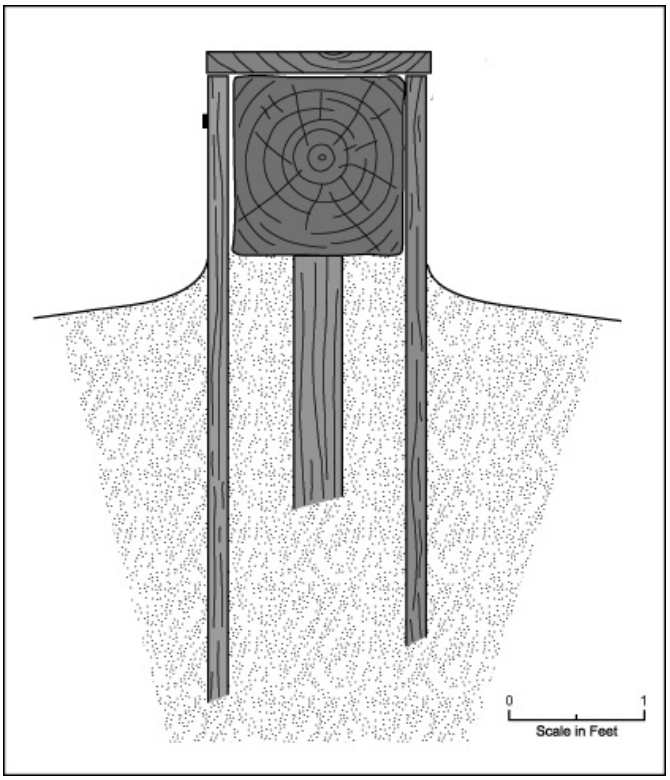


Figure 50: Reconstructed Bulkhead

A mortise joint, measuring 3 x 6 inches and 5.5 inches deep, had been cut into the surface of the large horizontal timber, near the west end. A fragment of cedar timber, measuring approximately 8 x 8 inches in cross section, was recovered from the fill above the bulkhead. A 4-inch tenon, cut to fit the mortise at an angle of approximately 20 degrees from vertical, was present at one end of the timber (Figure 51). The final element of the this portion of the bulkhead was a heavy, 2.5 x 18 inch plank capping both the sheet piles and reinforcing timber. The plank had two mortise holes cut into it, one matching the mortise in the large timber below. The upstream edge of the plank, overlying the tops of the sheet piles, bore a beveled finish, while the downstream side, that lay against the bank, was squared off. The capping plank may have served as a shoe, a replaceable buffer to protect the underlying timber from damage. It is, in fact, unclear what kind of damage the timber may have been shielded from, since the specific function of the structure is not known. Yet, the presence of the mortise and tenon feature and the protecting shoe imply that there was some sort of heavy activity associated with the

structure. Fasteners attaching the capping plank and the sheet pilings to the large timber consisted of large cut nails and spikes.

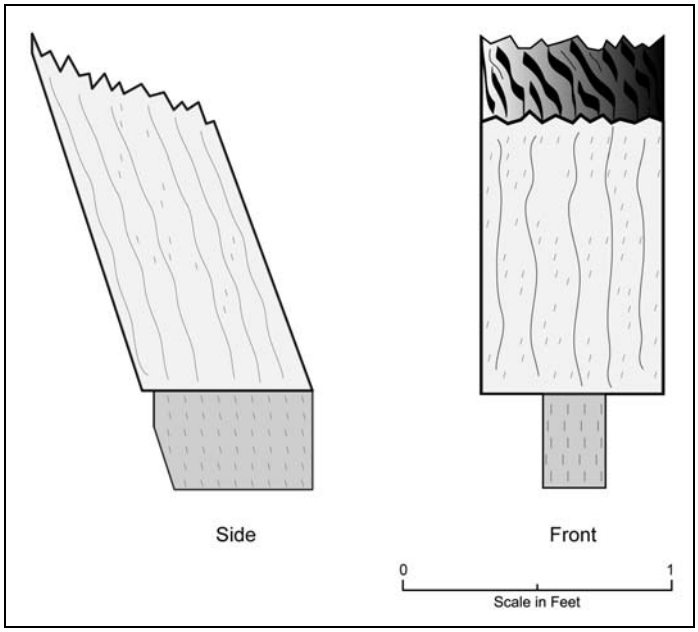


Figure 51: Cedar Timber with Mortise Joint.

At the east end of the feature, near the point at which it was truncated by the cofferdam, there was a formal break in the sheet piles. A series of 2.5-inch-diameter pinewood posts had been placed across the opening to form a grate, designed to catch large debris. One of the posts was removed for examination and was found to measure 54 inches in length, with the end trimmed to a point for driving into the subsoil. A large, 7-inch-diameter post was also present in the gap. It probably served as support for the large reinforcement timber, although both the post and timber appeared to have been displaced when the timber was pushed down and twisted by the force of the cofferdam sheeting. The opening in the sheet piling was at lest 2 feet wide (the east end was truncated by the cofferdam). Debris, such as twigs, leaves and roots, lay in a dense mat against the base of the bulkhead. The material was particularly dense against the grate, and subsoil was washed out in a wide basin upstream from the opening, where water had eroded the sandy bottom deposits as it streamed through the opening.

An irregular gap, measuring about 7 feet in width, occurred between the sheet piling in the corner of the cofferdam and the piles in the channel, suggesting that the bulkhead had been disturbed by the construction of the 20th-century bridge. Further evidence of this was seen in a cut-and-fill sequence within the gap, indicating that the stream had cut through the opening, probably forming a temporary channel or chute during construction.

The sheet piles that lay in the stream channel, investigated as part of the survey and testing phase of the project, were more fully examined once the cofferdam was in

place and the flow of Gravelly Run diverted into the metal culvert. The deteriorated wood, originally identified as short segments of parallel planking, was indeed part of Bulkhead 2. Excavation revealed two sets of sheet piles. The longest was roughly aligned with the portion of the bulkhead to the east (described above). It extended 19 feet from the gap east of the stream channel (caused by the east bulkhead of the 1936 bridge), to a point at which it was truncated by the west bulkhead of the 1936 bridge. After a space of approximately 4 feet, the remaining sheets of Bulkhead 2 appeared, extending westward to the wall of the cofferdam. This part of the bulkhead was excavated as Feature 16. Three posts, Feature 19 (6 inches in diameter) and Features 25 and 26 (3 inches in diameter), were located south of, or downstream from the sheet piles, serving either as supports or alignment posts.

Upstream from the first line of sheets lay a second line, extending from the western edge of the present stream channel for a distance of about 14 feet. The distance between the two sets of pilings ranged between 10 and 12 inches. The planks making up the second line were more varied in width than those seen in the rest of Feature 2, ranging from 9 to 14 inches. In addition, the ends of the second set were finished differently; while they were single beveled, like the other planks, they had not been pointed. While seemingly minor, these differences suggest that the two sets of pilings were not put in place at the same time. An extensive cut-and-fill feature, designated Feature 24, lay adjacent to the upstream face of the bulkhead. This feature is described in detail below. In summary, it appeared to have been a deep erosional feature caused by backwash that scoured the stream bottom and undermined the bulkhead. The heavy rubble used to fill in the eroded area was noted between the two lines of pilings, and upstream for a distance of 3 to 4 feet. The second line of sheet pilings thus may have been an attempt at shoring up or reinforcing the most vulnerable part of the bulkhead, following the washout.

Features 16 and 15

As noted above, additional portions of the bulkhead lay to the west, across a gap of 4 to 6 feet that represented the disturbance caused by construction of the 1936 bridge bulkhead. The features were excavated separately, before the full configuration of the bulkhead was clear, and thus they were given separate feature numbers: Feature 16, two parallel segments of sheet piling; and Feature 15, an associated post. The planks making up Feature 16 were aligned with both sets of sheet pilings in Feature 2, to the east, indicating continuations of both lines, and that the upstream set of sheet piles, the repair to Bulkhead 2, extended well west of the stream channel. Feature 15 was a single pinewood post, 3 inches in diameter, lying on the upstream side of Bulkhead 2.

Feature 24

This was the only non-structural feature documented in the excavations. It consisted of a deep basin on the upstream side of Feature 2. The basin was filled with rubbly debris that included brick bats, large and small masses of slag, gravel, and black silty sediment that may have been decomposed coal. There were no chronologically diagnostic artifacts in the debris that could be confidently assigned to the period of deposition. (need to double check this statement) The basin measured approximately 20

feet in length, parallel to the sheet piling of Feature 2, and 3 to 4 feet wide at its widest point, near the center of the present stream channel. The cut was deepest near the face of the sheet piles, where it measured as much as 3 feet in depth. It was shallower and ill-defined to the west, away from the channel.

Feature 24 appeared to have been a deep erosional cut caused by backwash as water struck the bulkhead. Whether this occurred as a result of the continuous flow of the stream or was the result of a single, violent flood event is difficult to determine. In either case, the result was that backwash scoured out the sediments in front of the bulkhead and threatened to undermine the sheet pilings. The less well-defined nature of the feature west of the channel is consistent with this interpretation, since there would be lower energy flow away from the main channel, resulting in a shallower and less prominent cut infilled with finer sediment.

Wing Wall

Feature 7

Feature 7 consisted of an alignment of sheet piles extending northwestward from Feature 2, at an angle of approximately 40-45 degrees from the line of the bulkhead and beginning near its the west end. The individual planks, which measured 1.5 x 14 inches, were poorly preserved. All of the top ends were broken or deteriorated. As a result, precise elevation information was not available, yet all of the sheets were lower than the height of the complete portions of Feature 2. There were missing piles in two sections of the alignment, one near the cofferdam wall, and a second at the disturbance left by the 1936 bridge bulkhead. The latter occurred at the intersection of the wing wall and the main elevation of Bulkhead 2, so that the connection between the two sections of sheet piles was no longer present.

Feature 14, 22 and 23

A series of posts was located between Feature 7 and the cofferdam. Feature 14 was a 3-inch-diameter pinewood post; Feature 22 was a 5-inch-diameter cedar post; and Feature 23, a 4-inch-diameter pinewood post. Both Feature 22 and Feature 23 were adjacent to the sheet plies of Feature 7, and were aligned with it. Based on the configuration of the other bulkhead fragments excavated within the cofferdam, these posts would have supported a now missing timber that reinforced the sheet piles of the wing wall. The association of Feature 14 with Feature 7 was not clear, since the post lay more than 2 feet from the pilings.

BULKHEAD 3

Bulkhead 3 consisted of discontinuous fragments of sheet piling that stretched across the channel of Gravelly Run, along with fragments of wing walls extending upstream from both the east and west ends (Figure 44). While most of the individual features comprising the bulkhead were poorly preserved, the accumulated data from the remnants suggested that construction techniques were similar to those observed in

Bulkhead 2. That is, sheet pilings were driven into the sandy clay of the stream bottom, and reinforced by posts and massive timbers laid horizontally behind (downstream from) the pilings.

The components of the bulkhead were fragmentary; they were investigated and documented separately, given individual feature numbers as they appeared during excavation. The bulkhead pilings on the east side of the stream channel were designated Feature 8, and the corresponding posts were labeled Features 9 and 10 (Figure 52). The associated wing wall fragment on the east side of the stream was recorded as Feature 4. West of the stream, the sheet piles occurred in two sections, designated Features 11 and 17. Feature 12 was an associated post, while the wing wall on the west side was designated Feature 5. Scattered posts near the middle of the stream channel were designated Features 6 and 21. There were no surviving sheet piles from Bulkhead 3 in the stream channel.

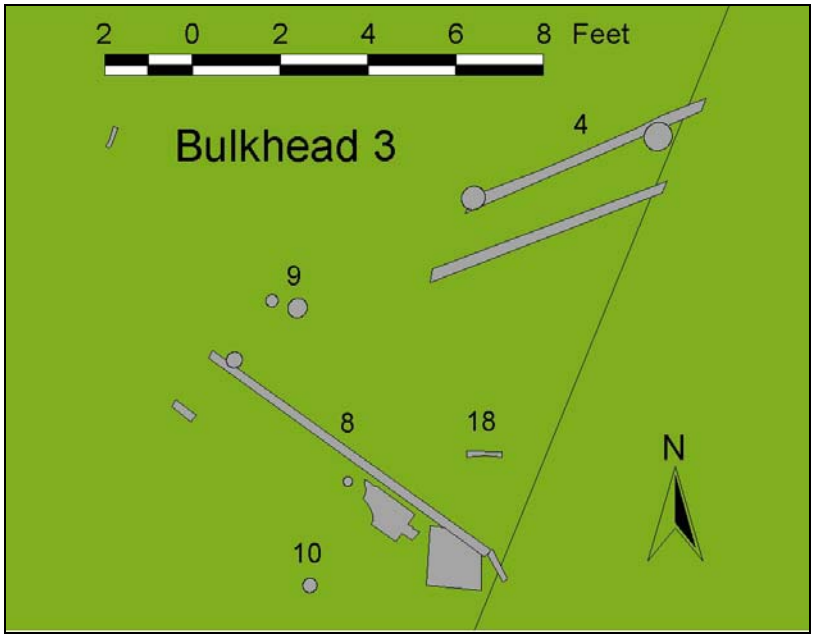


Figure 52: Bulkhead 3 on East Side of Stream Channel

Feature 8

Feature 8 consisted of a series of sheet piles, oriented parallel to Feature 2 (Figures 53 and 54). The planks measured 2 x 10.5 to 2 x 12 inches, and had been driven into the stream bottom and cut flush at or near present mean sea level. Like the sheet piles in Feature 2, these planks had been single-beveled to force them together as they were driven into place. They were shorter than the planks in Feature 2, measuring about 5 feet in length. Circular saw marks were visible on the plank faces. Estimates of the diameter of the saw were made both manually and mathematically (measuring the rise and chord): the estimated blade diameter was 35 to 45 inches. Two-foot diameter circular saws were introduced in the US in 1819; they were common in Maryland by the 1830s and 40s (Marsh 1998).

Four-inch-diameter pinewood posts were located directly behind (downstream from) the sheet piles. Individual sheet piles, that may have served as alignment planks, were situated in a line beyond the posts, approximately 15 inches from the main face of the bulkhead. While no reinforcing timber was observed on top of the posts, the spacing of the planks and posts suggested that one had originally been present. A large timber measuring 12 x 15 inches in cross section was noted near the cofferdam wall, but it sat vertically in the sediment behind the sheet piles. The timber did appear to be similar to that used to reinforce Feature 2, and its unusual orientation may have been the result of disturbance associated with the cofferdam installation. A deteriorated 2 x 20-inch plank was located in the fill directly above Feature 8, and may have been a capping plank disturbed by the cofferdam sheets. While no mortise holes were noted in the plank, a fragment of cedar timber, 5.5 x 8 inches in cross section, with a 4-inch tenon cut at one end was also found in the fill directly above Feature 8. The end of the timber opposite the tenon had been burned.

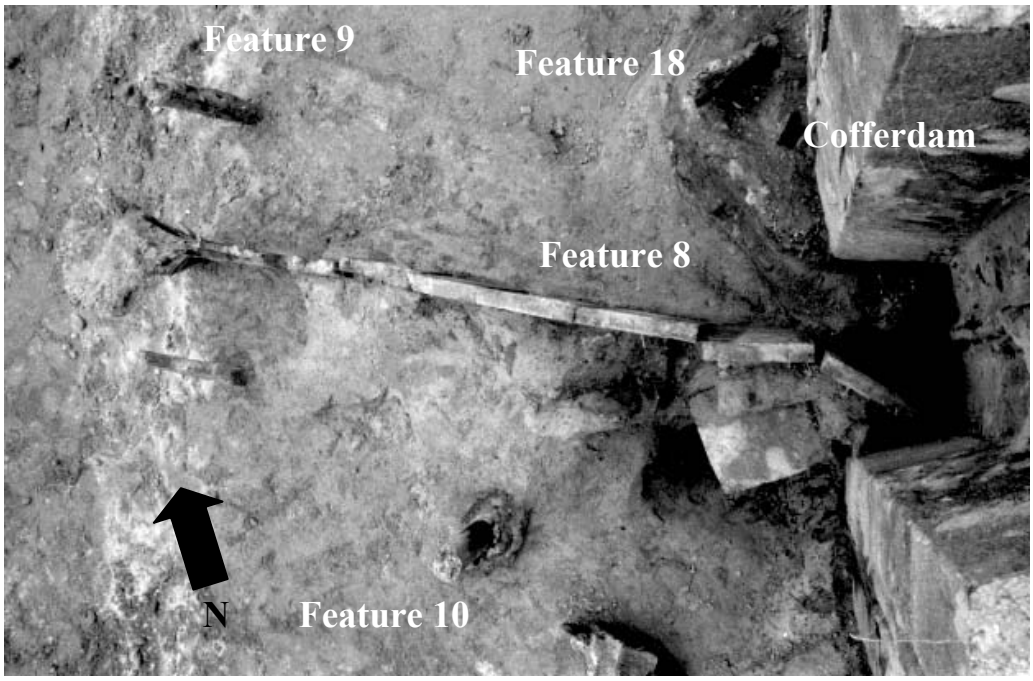


Figure 53: Planview of Bulkhead 3, Feature 8.

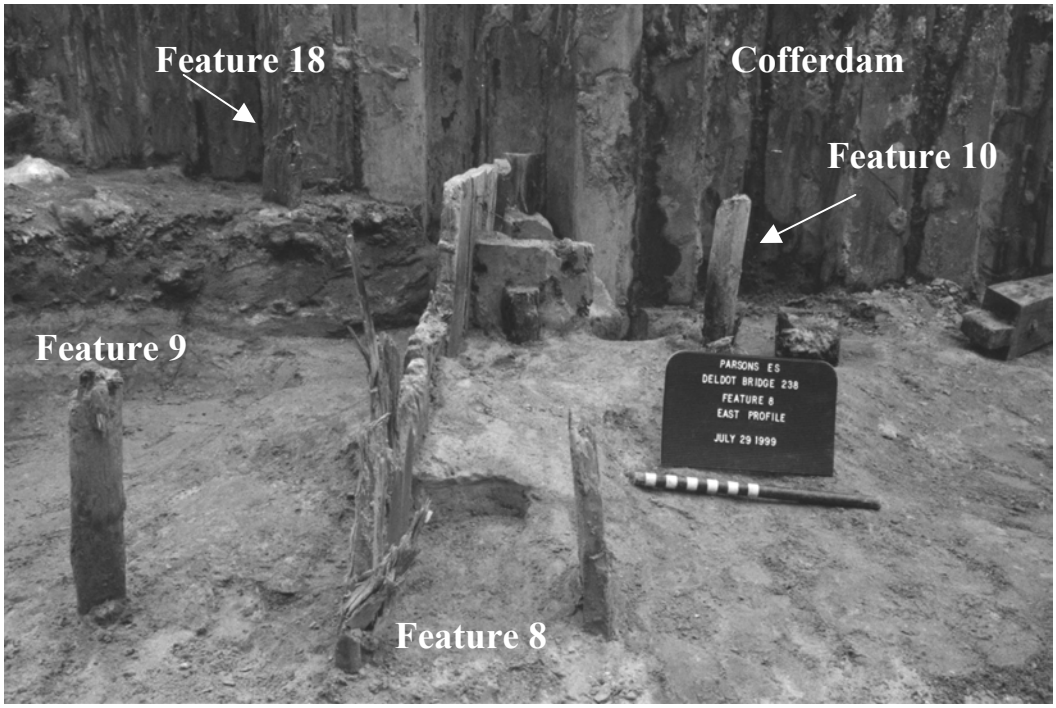


Figure 54: Bulkhead 3, Feature 8, Facing East.

Subsequent to the excavations within the cofferdam, Parsons monitored excavations for the installation of wing walls for the new bridge. These excavations were perpendicular to the cofferdam. Excavations for one of these wing walls exposed further remains of Feature 8. Observation showed that feature 8 extended an additional 2 feet into fast land from what was visible in the cofferdam. This shows that most of the foundation remains were exposed by the cofferdam excavations, and that little more can be expected outside the footprint of the new bridge.

Features 6, 9, 10, 21

Four additional posts, Features 6, 9 and 10, were located near Feature 8. Feature 9 was 4-inch-diameter pinewood post that lay 18 inches upstream from the bulkhead. Feature 10 was a pinewood post of similar diameter, located 2 feet south of the bulkhead sheet piles. Both posts consisted of sharpened but unfinished wood, with bark still remaining on the exterior. Their specific function in relation to the bulkhead could not be determined. Features 6 and 21 were highly deteriorated pinewood posts on either side of the stream channel lying at roughly the same distance from Feature 8 as did Feature 10. While weathered, their original size appeared to have been the same as that of Feature 10 (4-inch diameter), and they probably served a similar purpose, possibly for general alignment during construction.

Wing Wall East of Stream Channel
Feature 4

Feature 4 consisted of an alignment of pinewood sheet piles extending northward from Feature 8 at an angle of 55-60 degrees. The planks measured 2 x 15 inches, and were approximately 45 inches in length. They were single-beveled, but not pointed, and had been driven into the clay subsoil. No saw marks were visible on the surface of the planking.

There were no posts visible behind the sheet piles in Feature 4, but a 10 x 10-inch timber lay horizontally behind (downstream from) the sheet piles. Two mortises were cut into the timber. One, facing upward, measured 3 x 6 inches; the second was cut into the south, or downstream face of the timber. The west end of the timber had been beveled to an angle of about 45 degrees. There was no indication as to whether these features were directly functional (the mortises intended for structural purposes, for example), or whether the timber had merely been recycled. Four-inch roseheaded cut nails were driven through the sheet piling to secure the timber. A 2 x 10-inch plank lay horizontally behind the timber. One end was beveled in a similar manner to the timber, suggesting 1) that the plank was a capping board knocked askew by the cofferdam sheets, and 2) that the bevel on the large timber was not incidental; that is, the timber and capping plank had been shaped together as part of a splice joint with an additional timber to the west.

Main Bulkhead East of Stream Channel
Features 17, 11, 12

Like the component features of Bulkhead 2, the parts of Bulkhead 3 west of the stream were more poorly preserved than the corresponding material on the east side of the channel. The main bulkhead pilings, Feature 17, were very fragmentary. Only two sheets (measuring 2 x 10 and 2 x 11 inches) and a fragment of a third were present. While there no horizontal reinforcing timber was noted, several elements implied that one once existed: a 4-inch-diameter pinewood post behind the sheets; cut nails near the tops of the planks; and a single vertical plank, parallel to and 15 inches south of the main line of sheets.

Feature 17 was truncated to the west by the cofferdam, and to the east by the construction disturbance associated with the 1936 bridge bulkhead. Features 11 and 12 comprised the only remnants of Bulkhead 3 between the modern bridge and the stream channel. Feature 11 was a vertical alignment plank located behind the bulkhead, while Feature 12 was a 4-inch-diameter pinewood post.

Wing Wall West of Stream Channel
Feature 5

Feature 5 consisted of the fragmentary remains of a line of sheet piling that extended northward from Feature 17 at an angle of 45 degrees. The planks measured 2 x

11 inches. The tops of the planks were deteriorated, and thus it was difficult to obtain an accurate height measurement, but the level was somewhat above that of either of the two bulkheads, Feature 17 or Feature 2. The northern end of Feature 5 may have been the formal end of the bulkhead, since clean sediments, with no evidence of additional, now missing planks, were noted between the last plank and the cofferdam wall. The sheet piles extended approximately 5 feet to the east, toward the stream and Feature 17, while the molds of rotted or extracted planks continued an additional 4 feet, at which point they met the disturbance from the 1936 bridge bulkhead.

MISCELLANEOUS

Feature 3

A series of upright timbers or planks observed beneath the 1936 bulkhead during the survey and testing phase of the project. The features were only visible at low tide, and while not clearly defined, appeared to be oriented parallel with the later bridge features, rather than the earlier bulkheads that were the focus of the data recovery investigations. They were originally noted at the corner of the bridge abutment, but were not seen again during the excavations within the cofferdam. Based on their orientation, the planks may have been associated with the construction of the 1936 bridge.

Feature 13

A 4.5-inch-diameter pinewood post lying south of Features 11 and 12 (Bulkhead 3). The post was not associated with any of the documented bulkhead features, and its function is uncertain.

Feature 18

A single plank north of Feature 4. It measured 1.5 x 10 inches, and was heavily weathered. The plank was not oriented with any of the bulkhead features, and may have been part of the fill – it lay near the cofferdam wall and may have been pushed askew by the heavy metal sheets.

Feature 20

A 5-inch-diameter pinewood post, isolated south of Feature 2 in the main channel of Gravelly Run.

STREAM CHANNEL INVESTIGATION

Several backhoe cuts were made into the sediments in the stream channel. The purpose of the excavations was to better understand the dynamics of Gravelly Run – how its course may have varied through time and how that variation may have affected the presence or location of mill features, such as a wheel or waste gates.

One of the initial questions at the start of the investigation at Bridge 238 was whether or not there had been a mill structure here at the east end of the dam. Period maps indicate mills on the dam to the west, on the main branch of the Nanticoke, but by 1860 the only notation in the area of Bridge 238 was "Waste Gates." The question remained as to whether there had been an earlier, unmapped mill or forge on Gravelly Run – was the stream actually a millrace, leading to a wheel at the dam? It is conceivable that structural features were present but had been considered an impediment to bridge construction in 1936 and were thus removed prior to the installation of the modern embankment and bulkheads. If so, evidence of things such as a wheel pit might be seen in a filled-in excavation at or near the stream channel. In partial answer to this question, the excavations within the cofferdam revealed no structural remains that appeared related to a mill other than for water control.

Channel Excavation

The main archaeological excavation in the channel deposits was conducted parallel to the stream, on the east side of the diversion culvert. A trench, 4 feet in width, was excavated over a distance of approximately 35 feet as measured from the south wall of the cofferdam, 6 feet short of the length of the 1936 bridge bulkhead (Figure 42 – overall plan). The trench was excavated to an average depth of 7 feet below mean sea level, well into undisturbed Pleistocene subsoil.

South of Bulkhead 2, alluvial sand and gravel, representing the recent bed of the stream, began at a depth of 2.5 feet below mean sea level, and lay directly over sandy clay subsoil (Figure 55). Feature 24, the deep pit created by backwash, lay immediately north of the bulkhead. Beginning 3 to 4 feet farther north, beyond Feature 24, was a series of lens-like strata lying in a wide basin. Describing the strata from the bottom up, the base consisted of light gray sandy clay subsoil, consisting of the top of the undisturbed Pleistocene sands that underlie much of the Coastal Plain of Delaware. Lying directly over this sand in an abrupt transition was a layer of coarse sand and gravel. The distinct transition from the underlying subsoil to the coarse alluvium indicated that the subsoil had been cut, probably by fast-moving water. The latter conclusion stems from the size range of the gravel in the coarse-grained layer, since the material would have been carried by a relatively high-energy flow. These lowest strata, then, appeared to record the effects of a flood episode that cut a wide basin in the subsoil and deposited a layer of sand and gravel within it.

The gravel stratum was relatively uniform in thickness, measuring between 3 and 6 inches. Overlying it was a layer of gray colored, medium coarse sand mixed with small gravel. The transition to this gray sand was less sharp than the transition between the underlying layers, suggesting that the material was a natural alluvial deposit that had accumulated as the stream flow that laid down the coarser gravel lessened. The sand layer measured 6 to 12 inches in thickness, and stretched across the entire basin, from the deep deposit in front of Bulkhead 2 (Feature 24) to the north, or upstream end of the archaeological trench.

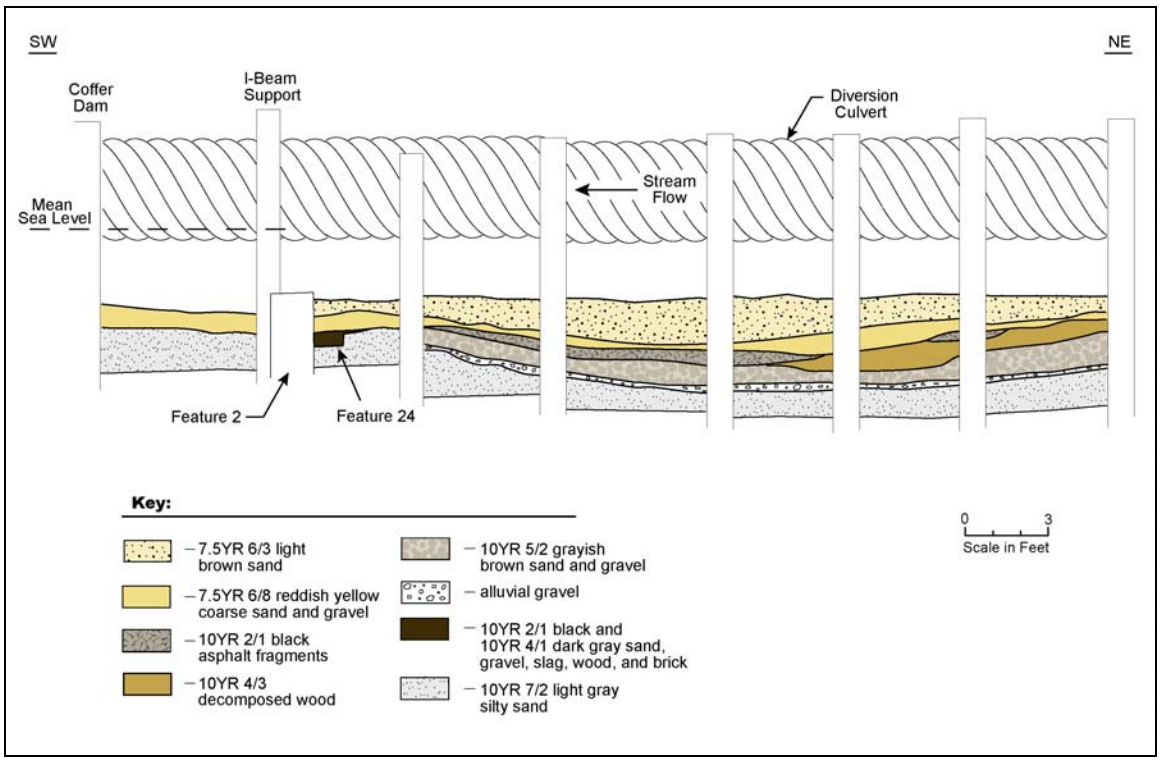


Figure 55: Stratigraphy, along Streambed.

The layers above the gray sand were more varied than those below. A deposit of heavy rubble, measuring 8 to 12 inches thick, stretched northward from Feature 24 for a distance of approximately 18 feet. The layer consisted largely of gravel and asphalt, along with fragments of concrete and metal. It sloped downward into the basin, where it eventually mixed with lighter gray sand that contained gravel, woods chips and branches. This woody debris layer was 3 to 9 inches thick, and sloped upward following the north edge of the basin. A thin, discontinuous layer of asphalt and gravel overlay the woody debris, suggesting that the wood layer was once more extensive, but had been cut and partially filled over by the layer of asphalt and gravel.

Overlying these two debris layers was a deposit of coarse brown, iron-stained sand, the upper portions of which were crusty and partially cemented in some places. The layer stretched the entire length of the trench excavation. It was thin throughout much of its length – 2 inches or less in thickness – but to the north it had accumulated in a low area to as much as 8 to 9 inches. This deposit appeared to represent the most recent base of the stream. Some of the material, including small gravels that lay near the surface of the deposit, had been lost to erosion during and after the cofferdam was installed, as water continued to flow from the culvert and from gaps in the cofferdam wall.

A final layer of sand covered the entire basin, consisting of a light brown to yellowish brown medium to fine grained sand, that measured as much as 18 inches in depth. This deposit was a recent addition to the basin, and was comprised of fill material

from the 1936 bridge bulkheads that had washed into the stream channel during the installation of the cofferdam and diversion culvert, as well as during the archaeological removal of the bulkhead fill.

Possible insight into the timing of the flood that produced the basin just described was provided by a local informant, who noted that the road that is now S 46 was washed out in a heavy storm in the 1930s. This was probably the 1935 flood that washed out the bridge, necessitating construction of Bridge 238 (DelDOT 1991). The informant noted that it was "the old 9-foot road" that washed out. The 9-foot road was the county road that consisted of a single lane of concrete pavement, nine feet in width. In the first quarter of the century, there was little enough vehicular traffic on most roads that a single lane was all that was necessary. When on-coming traffic appeared, vehicles would move to their respective shoulder and share part of the paved road. As traffic and speeds increased, so did the need for a road that could carry opposing lanes. The bridge over Gravelly Run may have remained a single lane until it was destroyed in a flood, occasioning the construction of the two-lane Bridge 238. Thus the wide basin north of Bulkhead 2 appeared to have been the remains of the flood that destroyed the older bridge, while the concrete and asphalt debris observed in the basin may have been the remnants of the ensuing demolition used to fill in the stream channel.

While excavating the trench, the equipment operator noted that the backhoe was less stable the farther north along the trench he excavated. This suggested that the underlying sediments were unconsolidated, probably consisting of the same fill sequence documented in the archaeological trench. It appeared, then, that the backhoe had crossed over the original channel, which lay more to the east than it does today. And as indicated earlier, were the channel located in this area, it would have been perpendicular to the bulkheads found archaeologically.

CONSTRUCTION MONITORING

Subsequent to the excavations in the cofferdam, Parsons monitored installation of new wing walls for the new bridge. During monitoring of the wing wall installed at the southeast corner of the bridge, timbers were encountered that were likely the extension of Feature 8, where the wood foundation originally extended into fast land (Figure 56). The monitoring results suggest that Feature 8 extended less than four feet beyond what was exposed in the cofferdam.

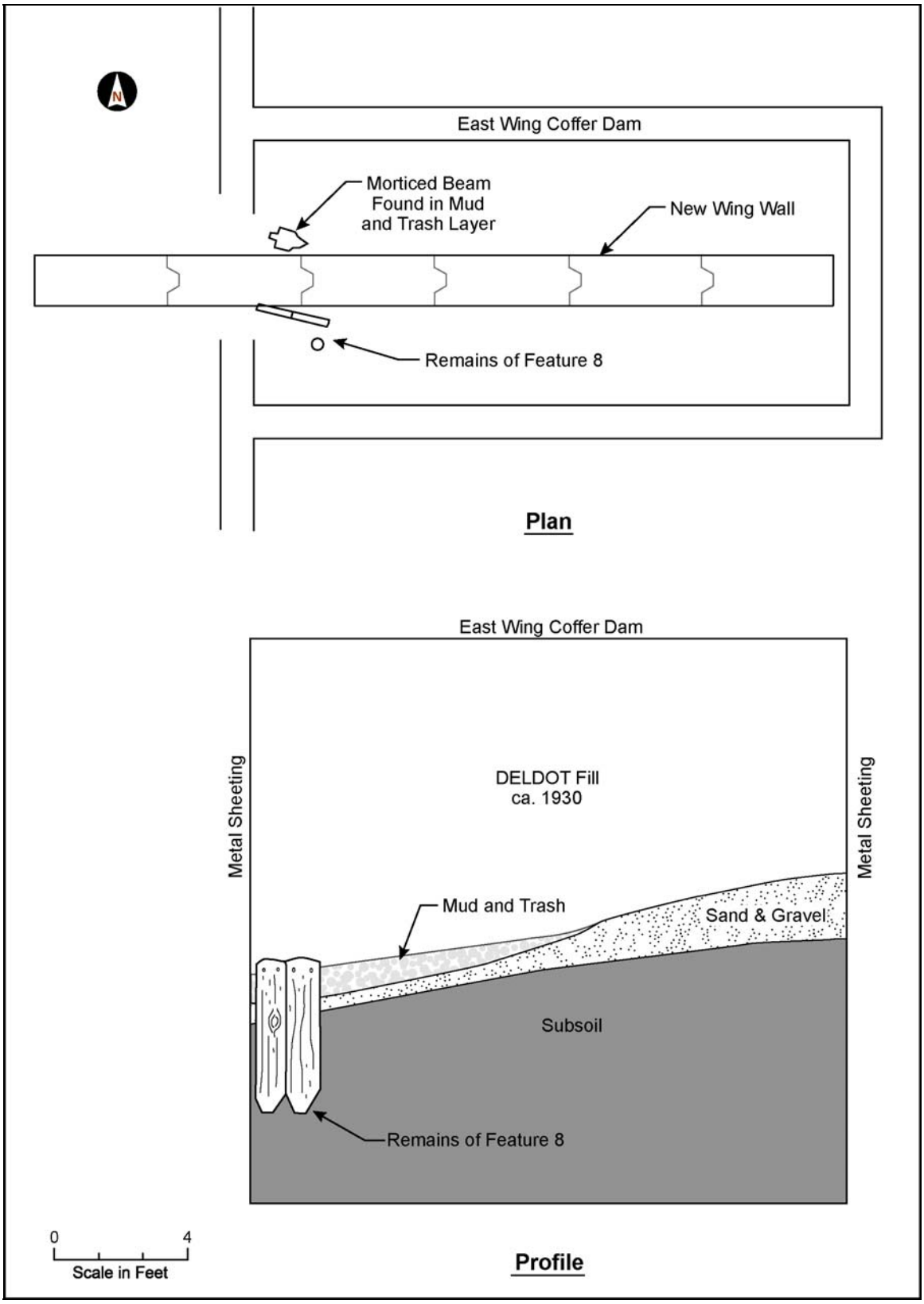


Figure 56: Wing Wall Monitoring, Plan and Profile Views.

CHAPTER 6: FEATURE INTERPRETATION

While their function could not be absolutely determined, the features appeared to represent low bulkheads or footers for a superstructure over the stream channel. Features 2 and 8 were most intact on the east side of the cofferdam. Based on the surviving portions of each, the structures consisted of a series of large horizontal beams supported by a line of 4-inch diameter posts, driven into the subsoil. The beams were lined on the north, or upstream side with vertical planks, serving as sheet pilings. A final element consisted of a 2x18-inch plank overlying, or capping the horizontal beam. Vertical mortise joints had been cut into the horizontal beams, and a fragment of timber bearing a tenon to fit the mortises was found in association with each feature. These bulkheads appeared to have wooden wing walls associated with them. In some ways, these features resemble features found during excavations at Cubbage Mill, Sussex County, DE (Figure 57).

Figure 57: Excavations at Cubbage Mill. Photo courtesy of Greenbank Mill Associates.

There was no evidence of a floor associated with any of the features, such as might be expected to be associated with a wheel box or with formal waste gates. This conclusion is based on excavation that exposed undisturbed clayey subsoil in all areas within the cofferdam. Deep mechanical excavation along the centerline of the present channel did provide evidence of a bridge wash-out in 1935, which prompted the construction of Bridge 238 in 1936 (DelDot 1991). The washed out area began approximately 5 feet north of Feature 2 (clearly separated from Feature 24), and

continued upstream for a distance of 25 to 30 feet, crossing the line of Feature 8. At the lowest point, subsoil lay roughly 2 feet below the level encountered in other parts of the stream channel. The fill in the washed out area included a layer of asphalt debris.

The circular saw marks on the timbers suggest that the finds most likely date to the mid to late 19th century, rather than the early 19th century. This suggests that the remains were more likely related to the waste gates originally built before 1814 indicated on the 1860 map rather than mill remains associated with a forge built some time after 1805 and which was gone by 1826 (Figure 4). The late date implied by the saw marks may mean that the original gates required occasional repair, or were replaced in whole or part at some time, perhaps in 1857 when the gristmill was rebuilt. The vertical members suggested by the mortise joints could have supported a superstructure that housed the mechanism to raise and lower the gates. Such gates would have been needed to control water levels in the millpond.

It is also possible that these remains formed the foundation for a mill's wheel box, the floor of which no longer survives. It may be that flooring for either a wheel pit or for culvert-style waste gates once covered the identified timber elements. However, if this were true, the crash rack in Feature 2 would not have been exposed to water, but would have been sealed under the floor.

According to 19th-century mill literature some waste or flood gates were designed to be closed under normal circumstances with excess water flowing over the top of the dam. Hinges attached the gate to a sill running across the opening in the dam. The weight of water in a flood would cause the gate to swing open, relieving the excess water in the pond (Grimshaw 1882). The downstream side of such dams needed to be protected from the fall of water and logs that might undermine the dam. Dams built upon soft ground (clay or sand as opposed to rock) needed to be reinforced in some way. Typically some kind of wood foundation was used, such as wood pilings. A crib that was then filled with stone, or earth was sometimes used. Plain earthen dams were built without such foundations, but in large streams, or streams prone to flooding, this would be liable to wash out (Craik 1870).

Dams that carried roads could not use this method unless there was a bridge over the gate. Culverts or raised-board systems were also used that would allow a bridge to cross the gates (See Figures 58, 59, 60, 61).

The transverse features may also be bulkhead-like footers for removable-board waste gates with a bridge across the stream. The features are not perpendicular to the present stream channel, suggesting that the course of the channel was different in the 19th century, running slightly more to the west. Most of the structural remnants within the cofferdam were deteriorated, either heavily weathered or disturbed by construction of Bridge 238 in 1936. Thus it is difficult to say whether certain aspects of Features 2 and 8, such as the mortise and tenon joints and the spillway, were characteristic of the entire bulkhead structure or signal particular structures on the east side of the stream that lie largely outside the area of the cofferdam.

Comparison with existing waste gates in Delaware and New Jersey suggest possibilities for what the waste gates at Middleford Mills may have looked like. Some configurations, like that at Greenbank Mill outside Willmington, have a box-like culvert with two vertical gates. This design would include a floor all the way across the bottom of the gate. Since no floor was found at Bridge 238, the piles may foundations for a wooden floor that is now absent. This configuration might have resembled that for the floor of the wheel pit at Cubbage Mill. However, if the foundations identified under Bridge 238 were completely covered by a floor, the purpose of the crash rack in Feature 2 would be unexplained.

Figure 58: Culvert-like waste gates, Greenbank Mill, Willmington, DE.

Another possibility is that the bulwark features are the foundations of the dam, and the foundations for the gates themselves were in the middle of the channel, where remains were very fragmentary. However, if this was the case, then the wooden features would be expected to extend throught the dam itself, but excavation for the new bridge wing walls showed that Feature 8 extended only 2 feet beyond the cofferdam, and excavation for a wing wall on the other side showed no wood foundations at all.

A third possibility is that the waste gates at Middleford Mills could have resembled those at Kirby's Mill, Medford NJ. Here the gates consist of removable horizontal boards resting on a sill rather than gates that are raised. The boards are removed one-by-one to increase the water flow as desired. The boards rest between vertical posts or rails. Buttresses set at an angle parallel to the stream flow support these vertical posts. Such a configuration would explain the three parallel rows of sills running across the race found below Bridge 238—one sill to support the horizontal planks and the

other two to support the buttresses. This scenario would leave the crash rack in Feature 2 exposed to water flow, although the need for the crash rack is still unclear.

Figure 59: Removable-Board Type Waste Gate, Hearn and Rawlins Mill, Seaford, DE.

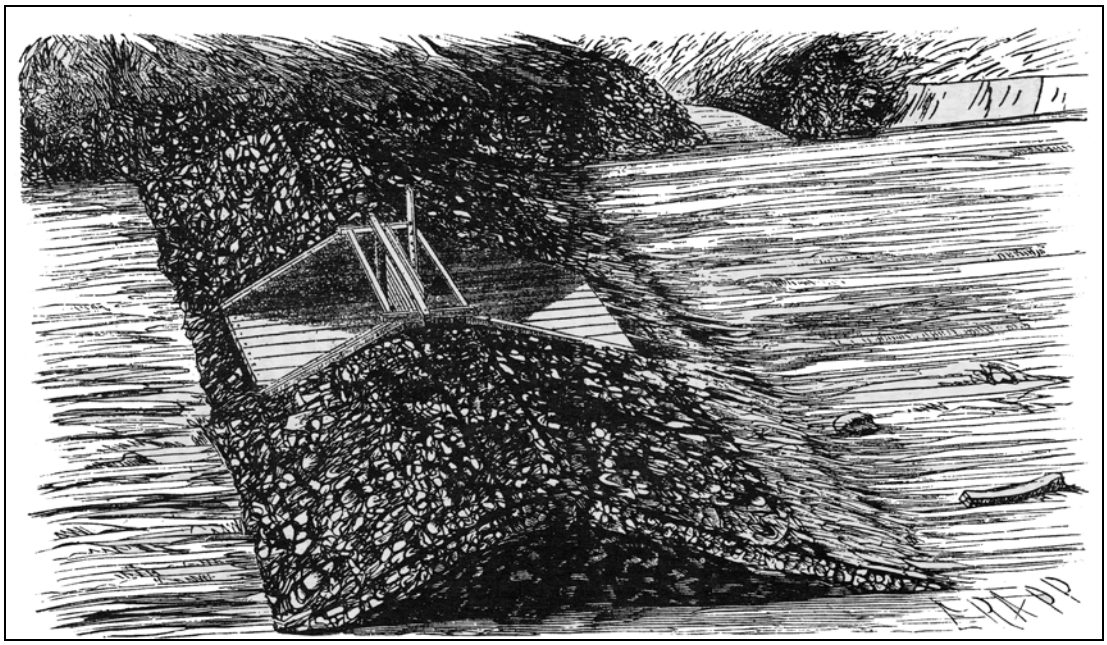


Figure 60: Waste Gates in Rip Rap Dam (Leffel 1880, p. 19).

Figure 61: Removable-Board Type Waste Gates; Kirby's Mill, Medford NJ. Courtesy Greenbank Mill.

CHAPTER 7: SLAG ANALYSIS AND IRONMAKING

INTRODUCTION

Historical documentation shows that there were at least two forges that once operated at Middleford Mills. While the precise location of the forges is not known, there are two known slag piles that may correspond to the original locations. Slag is a by-product of iron production and includes silicon, phosphorus, sulfur, aluminum, ash, and unrefined ore. Samples of slag were taken from one of these piles, as well as from iron ore and slag found scattered in the vicinity of Bridge 238, to determine whether these artifacts have any research potential related to the history of iron making in Middleford.

HISTORY OF IRONMAKING

Two main types of forges, bloomery forges and blast furnaces, produced iron in Colonial America. A bloomery forge, such as the one present at Middleford, was named after the initial product of the forge, an approximately 100-pound bar called a bloom (Rolando 1992:17). A bloomery forge used bog ore, or limonite, to produce wrought iron, a fairly soft, carbon-free iron. This was fashioned with relatively little effort into horseshoes, wheel rims, or plows, or drawn into rods to make nails. Bloomery forges reduced iron directly from bog ore into blooms that were inferior to iron refined from pigs in blast furnaces. A blast furnace, named for the large blast of air that was needed to maintain high temperatures within the furnace stack, produced cast iron, or pig iron, containing large amounts of carbon. Because cast iron is too hard to hammer, the pig was then sent to a refinery forge and molded (cast) into desired shapes, such as potash kettles, tools, stove plates, machine gears, ingots or bar iron (Rolando 1992:17).

The bloomery forge process of iron production was a very inefficient one; however, the process remained popular because it required a much smaller initial investment of money and labor than a blast furnace (Rolando 1992:20). The average furnace required 4 tons of ore and 300 bushels of charcoal to produce a single ton of iron, which required furnace companies to purchase thousands of acres of land just for wood fuel (Rolando 1992:20). A bloomery forge consumed less fuel and required less time to achieve the desired temperature compared to the large blast furnace, which took days to slowly bring up to operating temperature. While the blast furnace had to remain in continual operation both day-and-night for months, the bloomery cycle ended with the removal of the bloom from the hearth. This meant that a bloomery forge could respond easily to fluctuations in the supply of ore and fuel, as well as the demands of the market. Since the domestic needs of blacksmiths forging horseshoes and door hinges could be better met by the direct ore-reduction process of the bloomery, these small ironworks across the Delmarva region became more significant contributors to the market needs of colonial Delaware than did the blast furnace.

Many people viewed American iron as a convenient alternative to Swedish or Russian iron, while others considered it an inferior product but nevertheless a source of potential competition with the British iron industry (Mulholland 1981:106). The Iron Act of 1750 allowed for the export of pig and bar iron from the colonies but did not allow the colonies to construct rolling mills, plating forges, or steel furnaces. Bar iron exports from America rose only slightly just after the Iron Act and exports from the Chesapeake Bay region remained stable at 2500 tons per year (Mulholland 1981:107). Exports from the New York and Pennsylvania regions increased from 200 to 1,000 tons per annum as a result of the building of new furnaces. By the mid-18th century, colonial industries were utilizing the expanding domestic market by producing utensils, tools, and implements. By 1775, the colonies had built more than 80 furnaces, and possessed at least 175 forges, exceeding the number of similar facilities in England and Wales (Mulholland 1981:108, 116). With exports sufficient to rank the colonial iron industry third in the world, behind only Russia and Sweden, the American colonies, with a much smaller population, were out producing both England and Wales.

PIXE ANALYSIS

Parsons conducted a pilot chemical analysis several samples of slag in order to explore the information potential of this type of artifact. Parsons sent (13) samples to Charles Swann of the University of Delaware for PIXE analysis. Particle induced x-ray emission (PIXE) is an elemental analysis technique that was developed by Sven Johansson, a nuclear physicist at the Lund Institute of Technology in Sweden, in 1970. In this technique, a sample is irradiated with a proton beam produced from pure hydrogen by a linear accelerator. The protons interact with the electrons in the inner shells of the sample atoms, which creates inner shell vacancies. X-rays, with energies that are unique to the individual elements of the periodic table, are emitted when electrons from the outer shells refill the vacancies. The number of these specific x-rays emitted is proportional to the relative amount of that element within the sample. Therefore, an element-specific analysis of a sample is provided through the PIXE technique. With Trace element detection, sensitivity can reach a few parts per million. In addition to its applications in fields such as nuclear physics, biomedicine, and atmospheric science, the PIXE technique now is being used in archaeological studies to characterize artifact materials, including metals, ceramics, lithics, and bone. The PIXE analysis technique offers advantages over other material characterization techniques, most notably its non-destructive nature, high sensitivity, and multi-element capability (Materials Research Science and Engineering Center 2001; Johansson et al. 1995).

Table 7: PIXE Analysis Results

Sample No./ Bag No.	Artifact No.	Test	Stratum	Material	Function	Notes
42	1	STP J-4	D	Furnace Byproduct		
43	4	Unit 1	A	Slag		
44	2	Unit 1	B	Slag		

Table 7: PIXE Analysis Results

Sample No./ Bag No.	Artifact No.	Test	Stratum	Material	Function	Notes
51	3	Unit 4	B-2	Bog Iron		
54	1		Surface	Furnace Byproduct		From mill race north of Bridge 238, prob. tap slag (with sand and pebbles adhered)
55	1		Surface	Slag		From vicinity of Point H in Figure 38
57	1	Feature 2		Ferrous alloy	Cut nail	From east side of construction
58	2	Feature 4		Ferrous alloy	Cut nail	From east side of feature
59	3	Feature 8		Ferrous alloy	Cut nail	From east side of construction
62	5	Feature 24		Slag		From fill
63	4	Feature 24		Slag		From west side
64	1	Feature 24		Charcoal		Charcoal/clinker/slag

1) Sample 42 was initially thought to be bog iron, and Sample 54 was thought to be slag. However, these are not slags but rather products of the interaction of hot slag with the bottom (earth) of the bloomery furnace.

2) Samples 51 and 63 are slags on one surface and the byproduct of hot slag interacting with the bottom of the bloomery furnace.

3) Samples 43, 44, 55 and 62 are all slags but may not be from the same bloomery or perhaps the same bloomery but at a different time.

4) Sample 64 is charcoal and likely the type of fuel used in the bloomery.

5) Samples 57, 58 and 59 are cut nails that have been cut from a sheet of iron from which the slag has been forced out and the carbon reduced by firing.

The results of the study appear to confirm the identification of the Middleford forge as a bloomery forge. The operators likely would have used bog iron as their source of ore (available locally) along with limestone as a flux, and charcoal as the fuel (Swann personal communication Feb. 13, 2002).

Because the compositions of the slag samples were found not to be uniform, the results suggest that chemical analysis of the iron samples and slag has the potential to illuminate the techniques used in manufacture, and to distinguish between material from the different forges. To carry the study further, a source of possible bog ore and the limestone used would be needed.

CHAPTER 8: HYDROLOGY AND OPERATING PARAMETERS OF THE MILLS

In order to understand the significance of the waste gates uncovered beneath Bridge 238, it is necessary to understand the hydrology of the system as a whole. The mills' hydraulic components (the dam, the pond, the wheels, and the waste gates) were interdependent. Mills worked by harnessing the energy released by falling water using a water wheel that transferred that energy to shafts and gears. In some mill systems, water was conveyed to the wheel by diverting water from a stream through head races. There were a variety of wheel types of varying efficiency. Overshot wheels were struck by water at the top of the wheel. In other mills where there may not have been sufficient change in elevation for this (fall, or head loss), water may have come to the wheel in the middle (breastshot), or low on the wheel (undershot). These wheels were sometime easier to build, but were less efficient than overshot wheels. A breastshot wheel might capture 40% of the water's energy compared to 65 to 75% for an overshot wheel (Colley n.d.; Knepper 1992). Turbines, invented in the 19th century, were more efficient still. Once through the wheel, tail races then conveyed the water away from the wheel. In Delware with its relatively low relief, millwrights created the fall of water needed to power mills by constructing dams across streams, and placing the mills on top of the dam.

The power available to such mills was a function of the height of the pond, which was in turn a function of the height of the dam (the greater the fall of water, or "head loss", the more energy was transferred from the water to the water wheel). How close to the top of the dam the pond elevation could be kept depended the inflow of water from the surrounding watershed and on the discharge capacity of the mills and waste gates. The quantity of water flowing into the pond varied with rainfall. In periods of heavy rain, the volume of water flowing into the pond could exceed the total discharge capacity of the mills and gates. If this happened, the level of the pond could rise until the pond overflowed the dam. Since this could have catastrophic consequences, it was important to ensure that either there was enough capacity in the mills and waste gates to discharge excess water, or the level of the pond was kept low enough to ensure there was enough extra capacity in the pond to contain a flood. The greater the capacity of the mills and waste gates, the higher the level of the millpond could be maintained without risking a flood. If the capacity of the pond was low, and the water supply from the river unreliable during dry months, there might not be sufficient water to keep the mills running at the desired capacity.

To understand the relationship between the Middleford Mill complex and the hydrology of the area, it is necessary to reconstruct the quantity of water flowing into the pond, the elevation of the pond surface, the volume of water in the pond, and the discharge capacity of the mills and waste gates.

The historical details of the Middleford pond were reconstructed using historical documents and GIS analysis of the local topography. Based on the elevation of likely 18th-century mill features, the original dam was probably not much higher than 5 feet

amsl, and was approximately 600 feet long. This pond was reconstructed in ArcView using the 5-foot contour line (Figure 62). The resulting pond would have covered 159 acres and held 67 million gallons of water.

Based on historical documents and the USGS 7.5 minute topographic map, the height of the 19th-century milldam appears to have been more than 10 feet amsl. This dam was approximately 1,200 feet long. The industrial census for 1880 describes the fall in feet for the Grist and Carding mills as 6 feet, and 7 feet for the Saw and Planing mills. The water below the dam would have ranged in elevation from 2.52 feet amsl at high tide, to -0.48 feet amsl at low tide, with the normal water level being 1.02 ft amsl (DelDot 1998). Since the average elevation of the stream below the mills is approximately 1 foot, this means the top of the pond was 7 to 8 feet above sea level. Using ArcView GIS software, a mill pond was reconstructed following the 10-foot contour line upstream from the dam, as well as following an 8-foot line extrapolated from the other data (Figure 63). The shape of a pond at 8 to 10 feet amsl agrees well with 19th-century maps depicting the pond (Figures 8 and 9). The millpond up to 8 feet amsl would have covered approximately 215 acres, and would have held approximately 388 million gallons of water. Thus, moving the dam downstream, lengthening it, and raising it by 5 to 6 feet produced a pond with nearly 6 times as much water as the earlier pond. Although the larger dam would have been more expensive to build and maintain, it would have allowed a higher head, and thus more power for the wheels. Moreover, the larger pond would have allowed the mills the run longer during dry months.

The rate of water flowing into the historic mill pond can be estimated using daily mean discharge data collected by the US Geological Survey from a gauging station (Station number: 01487000) located upstream from the mill on the Nanticoke River, near Bridgeville, DE. Data are not available for other tributaries flowing into the pond (Hurley Drain, Gravelly Branch above Fisher's Mill Bridge, Ake Ditch, or Turkey Branch). To derive an estimate of the total flow into the millpond, the watershed for the Middleford mills was constructed from a digital elevation model of Sussex County using the hydrologic functions of the Spatial Analyst extension in ArcView (Figure 64). This was compared to the size of the watershed for the gauging station, and the ratio was used to estimate the average daily stream flow past Middleford Mills. Daily data are available for this station from April 1, 1943 through March 12, 1984.

Using the estimates described above, the average daily flow past the mill area between 1943 and 1984, was 149 cubic feet per second, with a low of 11 c.f./sec, and a high of 4781 c.f./sec. (on Feb. 26, 1979). September and October averaged the least amount of flow with 80 c.f./sec. And 77 c.f./sec. respectively. March averaged the most flow at 264 c.f./sec. The slowest month in the data was September 1943, when the flow was only 17 c.f./sec. The month with the greatest flow was August 1967, with an average of 684 c.f./sec.

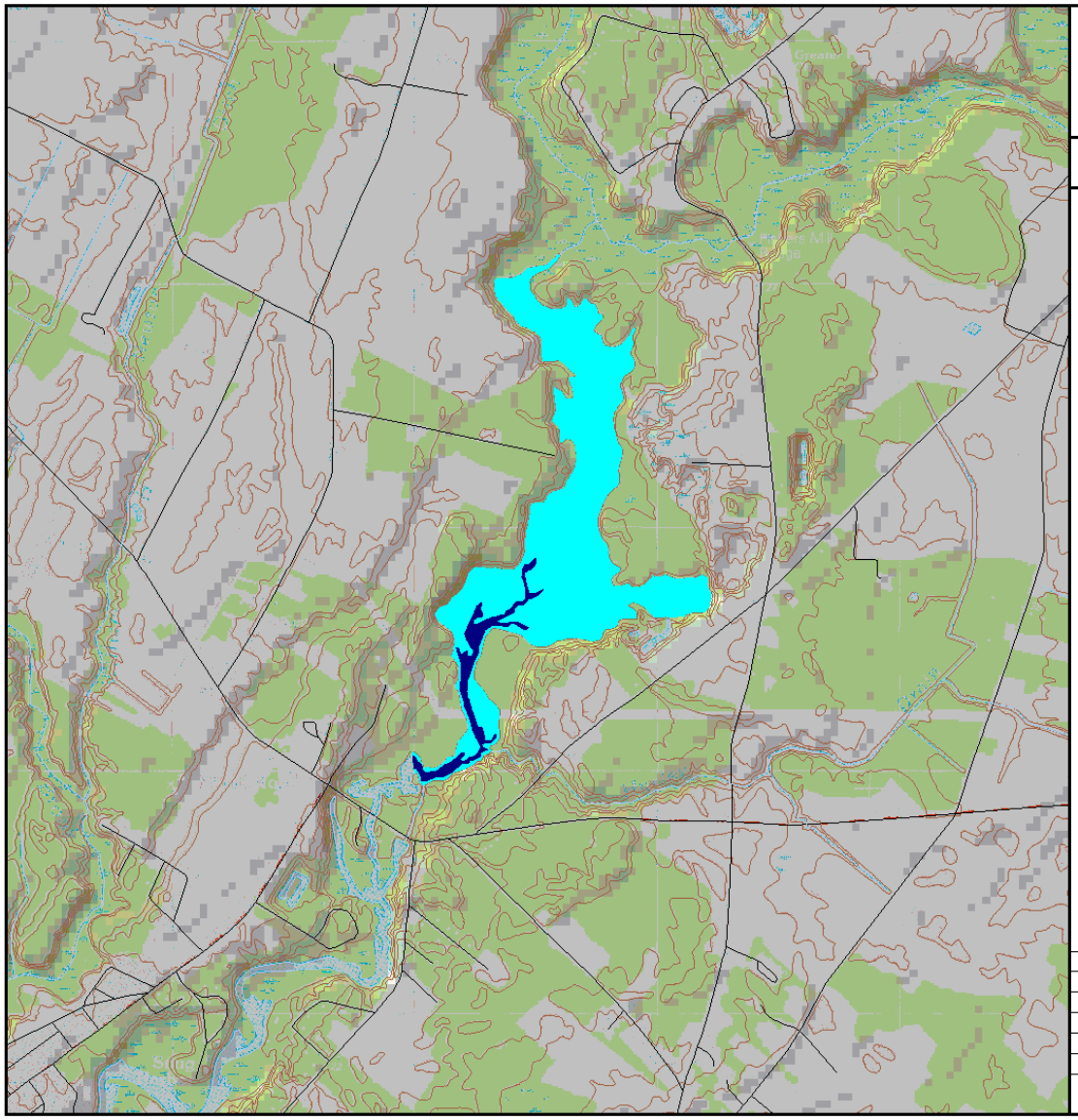


Figure 62: Reconstruction of the 18th-Century Middleford Mills Mill Pond

Pond Depth (ft.)

1

1 - 5

200 0 200 400 600 Meters

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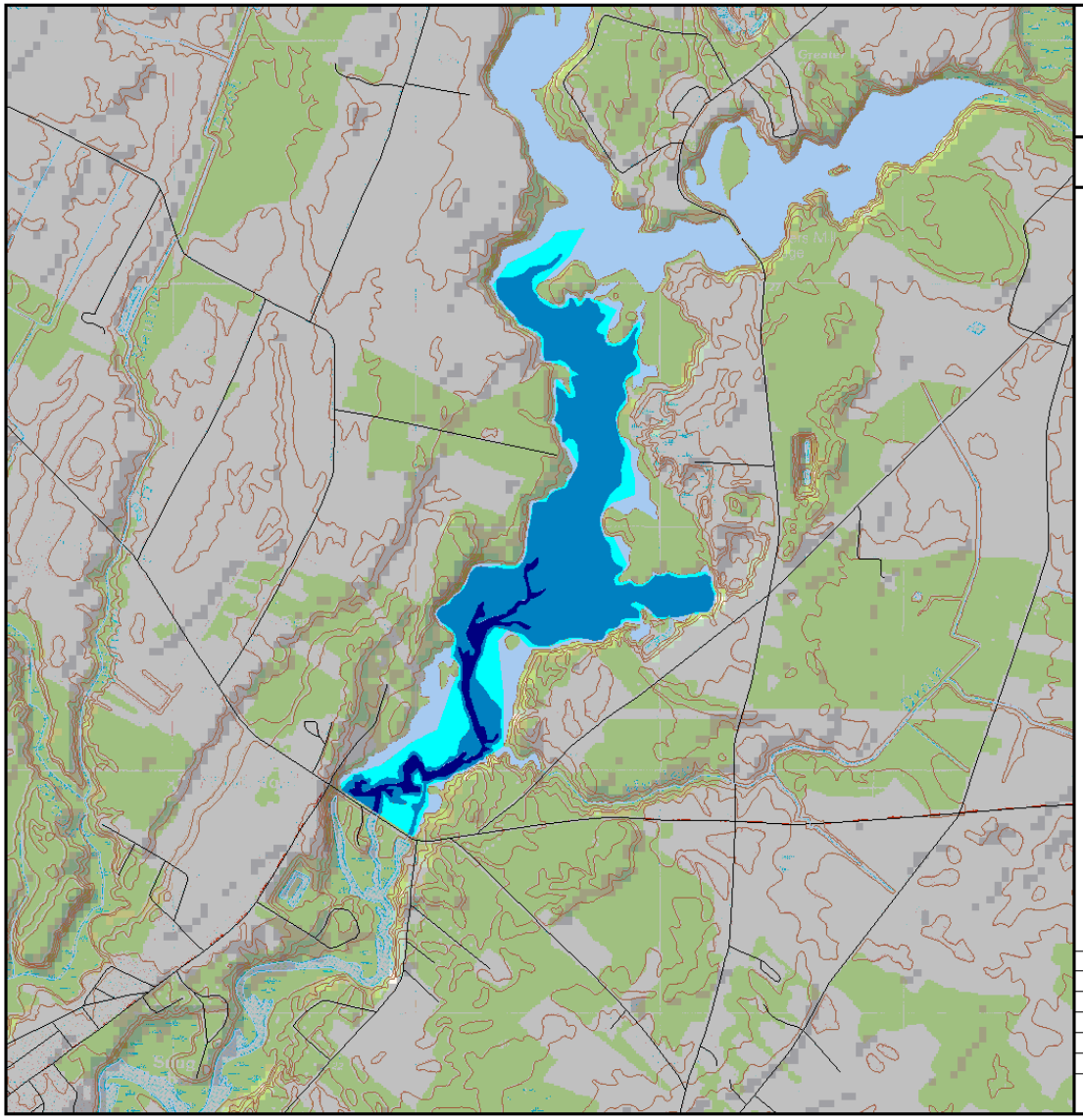

Figure 63: Reconstruction of the Middleford Mills Mill Pond ca. 1860

Pond Depth (ft.)
1
1 - 2.5
2.5 - 6
6 - 10

200 0 200 400 600 Meters

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Estimating the water consumption of the mills involves a formula using the height of head, the efficiency of the water wheels, and the horsepower produced. The 1860 industrial census shows that Lot Rawlins was operating a sawmill, gristmill, and carding machines. All were water powered, but the size and horsepower of the wheels is not given. The 1870 industrial census for Seaford Hundred lists a gristmill, sawmill, planing mill, and carding mill. Each was powered by an iron wheel; the gristmill wheel produced 20 horsepower, the lumber mill 20 hp, the planing mill 18 hp, and the carding mill wheel 10 hp. In 1880, the industrial census describes the gristmill as having 2 wheels with 6 feet of head, one with 25 hp, and another with 15 hp. It also lists a sawmill with one wheel of 48 feet in diameter, 7 feet of head, and 18 hp. There is no mention of a planing mill or carding mill; perhaps the second wheel listed for the gristmill had previously been used for the carding mill. These data are summarized in Table 8.

The type of wheels used is unknown. The 1880 industrial census describes the wheels as ranging in size from 30 to 48 feet in breadth. The breadth likely refers to diameter, but a 48 foot diameter wheel for a fall of 6 feet makes no sense. However, given that the wheels are iron, it is more likely that the wheels were turbines, in which case the power produced for a fall of 6 or 7 feet would be consistent with turbines 30 to 48 inches in diameter. Such wheels might have been expected to have an efficiency of between 70 and 80%. Assuming a 70% efficiency, the mills would have used 122.4 cfs of water in 1870 and 104.4 in 1880. Assuming a 30% efficiency in an undershot wheel, the mills would have used 285.3 cfs in 1870 and 243.4 cfs in 1880.

Table 8: Mills of Middleford Mills

Mill	Wheel Type	Horsepower	Diameter	Months in Operation	Water Consumption
1870					
Gristmill	Iron	20		12	36 cfs (turbine) 83.9 cfs (undershot)
Sawmill	Iron	20		10	36 cfs (turbine) 83.9 cfs (undershot)
Planing Mill	Iron	18		6	32.4 cfs 75.5 cfs (undershot)
Carding	Iron	10		3	18 cfs (turbine) 42 cfs (undershot)
1880					
Gristmill 1		25	36	12	45 cfs (turbine) 104.9 cfs (undershot)
Gristmill 2		15	30	12	27 cfs (turbine) 63 cfs (undershot)
Sawmill		18	48	12	32.4 cfs (turbine) 75.5 cfs (undershot)

The final element needed to reconstruct the operating parameters of the mill complex is the discharge capacity of the waste gates. This figure is based on a combination of archaeology and GIS analysis. The discharge capacity of the gates is largely a function of their dimensions. The waste gates excavated under Bridge 238 may have been as much as 40 to 45 feet wide, and about 10.5 feet high (from the top of the wooden sill, Feature xx, located approximately at sea level, to the top of the dam). The dimensions of the middle gates can only be estimated based on the width of the present channel, and the assumption that it would have had a design, and therefore a height similar to the other gates. The present channel is approximately 100 feet wide. Using the formula 0.98*width*height*SQRT(2*32.2*height) (Urbonas and Stahre 1993), the discharge capacity of the gates at Bridge 238 would have been approximately 24 cfs.

Using all of the data estimating discharge capacities and stream flow, a simulation of water levels was written using Excel. The simulation was intended to show whether the discharge capacity of the system was sufficient to prevent floods during periods of high rainfall, and whether there was sufficient water flowing into the pond to keep the mills running consistently during dry months. The simulation estimates the level of water in the 19th-century mill pond from the historical stream flow data, and adjusts the volume of water flowing through the waste gates to keep the estimated level of the pond between 6 and 8 feet amsl. The simulation was designed to shut off water to the mills if the water in the pond dropped below 7.5 feet amsl. This simulation showed that there was sufficient water to power the mills 98% of the time, assuming the mills did not run more than 12 hour per day. According to the Industrial Census, only the gristmill was in operation 12 months of the year, the sawmill was in operation 10 months of the year, the planing mill 6 months, and the carding mill only 3 months. The combined water use to generate the horsepower described in the 1870 census (122.4 cfs assuming a turbine) was less than the average stream flow for the Nanticoke (149 cfs), but substantially more than the flow during dry months (the average for October was 76.3 cfs, and the average minimum month flow as 54 cfs). That meant that all the mills could not operate during dry months without the dam to create a reservoir. However, the stream flow data and computer simulation suggest that there was more than enough water to supply the power needs for this level of production. In fact, there was considerable unused water capacity.

The computer simulation suggests that if the two waste gates together were able to discharge 130 cfs (the average daily flow is 149 cfs), then the pond would not have risen above the dam given conditions similar to the historical stream flow data. This assumes that the wheels in the mills are either undershot wheels, or if they are turbines, that they are able to discharge excess water around the turbine in addition to what the turbine used. Whether or not the middle gates could have accommodated more than 100 cfs will not be clear without excavating the foundations of the gates there.

In order to protect the mills from flooding, the portion of the dam containing the structures may have been slightly higher than the portion with the waste gates. The east side of the dam (where the two sets of waste gates were located) appears to have been

lower than the portion containing the mills. The elevation near Bridge 238 is now just short of 10 feet amsl. The portion of the dam where the mills were was above the 10-foot contour line, but how much higher is unknown. The portion of the dam that was lower than the rest was approximately 700 feet long (the dam as a whole was approximately 1,200 feet long).

In addition to heavy rain, the mill operators had to contend with the tidal nature of the Nanticoke. With high tide backing up to the dam, the discharge capacity of the dam would have been reduced. That this was of concern is illustrated by a letter from John Rawlins to James Rawlins from Georgetown in September 1878:

> *James,*
>
> *You doubtless have noticed the long continuance of this Easterly Wind, and thought of the Effect it has and will have to make full tides. If it passes off without the heavy fall of rain we sometimes have at the Equinoxeal, it would not effect as much; but a heavy rain storm might fill the ponds so full that we could not get clear of it with so much back water. I have no doubt you will commence running the water off in time and have the pond down, if there is a necessity to it. With best wishes, yours,*
>
> *JM Rawlins.*

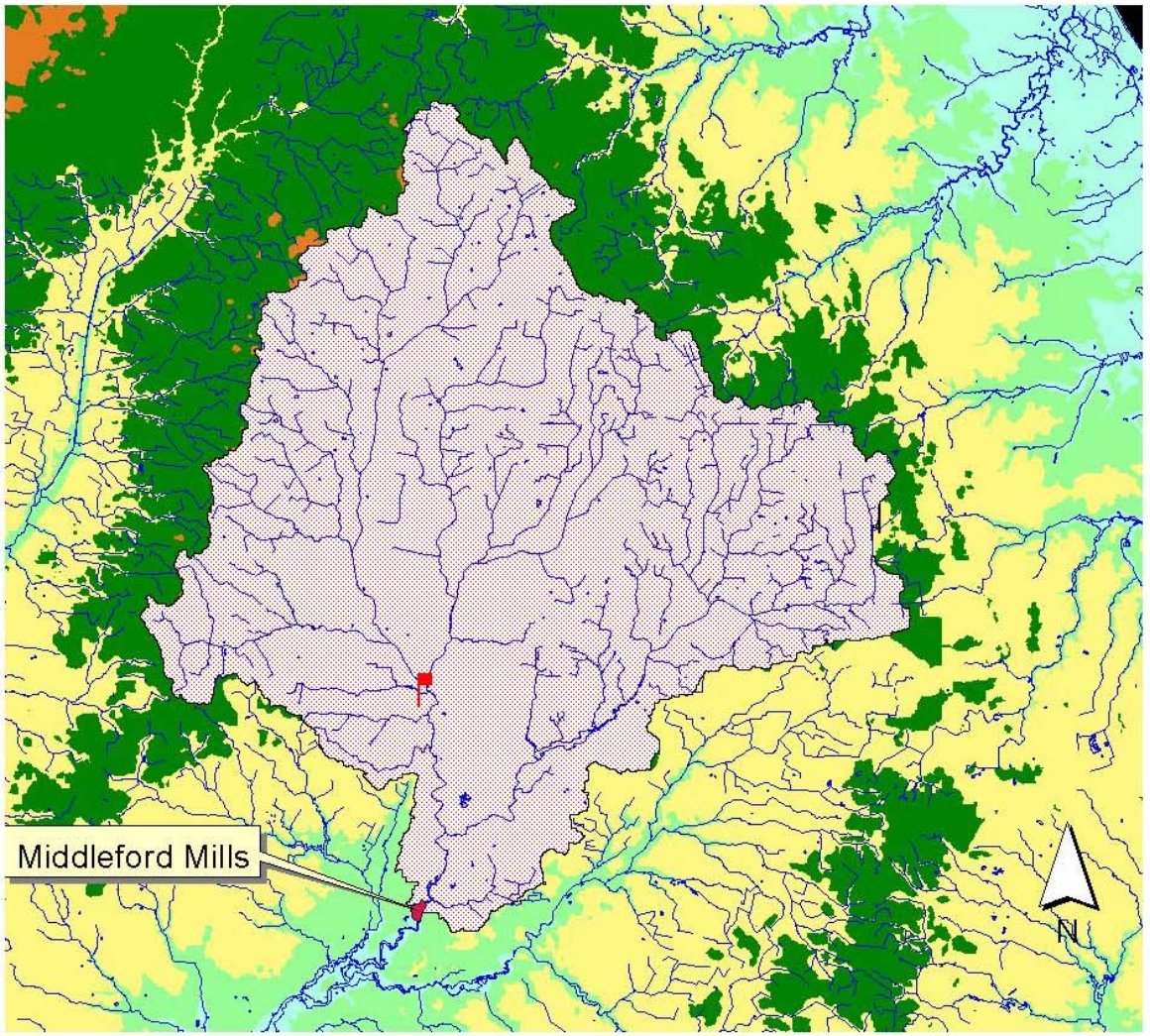

Figure 64: Reconstruction of the Middleford Mills Watershed

CHAPTER 9: CONCLUSIONS

THE ARCHAEOLOGY OF WATERPOWER

The hydrology of the Middleford Mills provides a context for understanding the operation of the mills during their nearly 150-year history. The first dam was built during the 18th-century to power a bloomery forge. The dam was later rebuilt downstream to create a larger, deeper pond, that powered as many as four mills.

The data suggest several reasons why the early dam was relocated after 1805. Moving the dam downstream, and making the dam higher created a pond with a higher head loss, greater capacity, and a longer dam that may have allowed for more openings, and consequently a higher discharge capacity. The Middleford Mills were rebuilt at a time when mill engineers were gaining an improved understanding of mill hydraulics. The greater power potential of a higher dam may have been made attractive by the innovations developed by Oliver Evans. Evans' design placed milling operations on multiple floors and was more efficient than previous designs, but required more power.

However, the mill redesign happened before the science of hydrology had advanced to the point where millers could accurately predict seasonal variation in stream flow. The field of hydrology was developing in the early 19th century, but would not mature until after steam had largely replaced water as the principal source of industrial power. The 18th- and 19th-century Middleford Mills seemed to have had an adequate water supply throughout their period of operation, although the later, 19th-century dam improved this. Other early 19th-century mill sites suffered from inadequate water supply. Some mill centers in New England were designed for year-round water flows much greater than was available. The Collins works, in Collinsville, Connecticut, had enough water to run at full capacity for 164 days a year (1,000 horsepower, and 674 cfs); while the Springfield Armory Water Shops in Massachusetts probably only had enough water to run 164 days (240 cfs) and the Whitney Armory may only have had enough water to operate 100 days out of the year (Gordon 1985). That the 19th-century mills did not use all of the available capacity suggests that the enterprise was limited by market forces, rather than available water. By the late 19th century, large, centralized roller mills had come to dominate the milling industry, and may have ultimately doomed the mills as Middleford.

Flood control at Middleford Mills may have been more of a problem than water supply. The 18th-century complex may not have had enough storage capacity in the pond, or discharge capacity through the dam to adequately control storm water. The simulation suggests that the post 1807 complex likely fared better in this, although the ability of the 19th-century waste gates to discharge sufficient water to avoid flooding during high water is still undemonstrated. The archaeology at Bridge 238 suggests the location may have been prone to flood damage in the past. For example, excavation of the stream channel showed evidence of gouging from a flood during the 1930s that washed out the bridge. The gate foundations contained circular saw marks, suggesting

that the original timbers had been replaced, and other features showed evidence of at least occasional repairs. Perhaps these repairs were needed because of flooding.

CONTRIBUTIONS TO EVALUATING MILL SITES

Just what can be learned from excavating a mill site is a common problem in archaeology. Review of some of the literature on mill sites, and discussion with those who have excavated mills, has sometimes shown a certain disappointment in what was actually learned about the site through excavation as compared with historical research. For example, upon completion of data recovery excavation at the East Creek Mill site in New Jersey, project archaeologists felt that excavation had not been as successful in addressing the research design focusing on milling technology as had documentary research (Morin 1991).

This is a matter of particular concern for DOTs because mills are common elements of the American landscape and are often associated with bridges. As DOTs face a growing number of bridge replacement projects across the country, the fact that many of these bridges may cross millraces, or are located along mill dams, means that the issues surrounding the evaluation of these resources will become more prevalent.

There are several reasons for the limits on the ability of mill sites to address questions concerning milling technology. The use of waterpower was a fairly conservative technology, and apart from the introduction of turbines in the 19th-century, the technology of milldams, races, and wheels may not have changed very much over time. Changes in the internal workings of mills are very difficult to get at through archaeology because the machinery from abandoned mills tended to be salvaged rather than left in place. This suggests that either mills do not have as much research potential as perhaps was thought, or that we may wish to reconsider the kinds of questions we bring to mills.

One research topic that archaeological mill sites have the potential to address is how well mill designers chose sites that would provide an adequate water supply to provide the power necessary for their operations. Recent historical research has shown that, at least among New England millers, water supply was a major problem, and that partly owing to a poor state of knowledge concerning hydrology, many mills suffered from inadequate power for their designs.

The results of the simulation conducted in the current investigation show that given detailed historical documentation of a mill system and archaeological preservation of certain of a mill district's hydrological features, it is possible to reconstruct the operating parameters of the mill complex and thereby assess the siting of the mill with respect to water supply. Particularly valuable historical data necessary for this reconstruction include:

1. Feet of fall;
2. Historical stream flow data;

3. Number of mills employed, and their horsepower;
4. Size and type of wheels used.

Archaeological dimensions that need to survive include:

1. Height of the dam (especially in areas like southern Delaware where mills were sited on the dams);
2. Width and depth of all waste gates;
3. Type of gates employed;
4. Dimensions of head and tailraces.

If all or most of these data can be collected, then it should be possible to reconstruct the optimum power needs of the mill, and how those compared to seasonal water supply. How well a mill adapted to the available water supply would provide information about how much the mill designers knew about the local hydrology (or how lucky they were) and what kinds of constraints there might have been on their business success. With these data available, the case can be made that the water control features within the mill complex retain sufficient integrity to provide important information related to economic history and the history of milling. If the complex lacks all or most of these data, then there may be little that can be learned about the hydrological operation of the mill, and thus the water control devices associated with it would be less likely to be eligible for the National Register.

THE VALUE OF MORE ARCHAEOLOGY AT MIDDLEFORD MILLS

Excavation and analysis of remains underneath Bridge 238 show that the mill-related features found there contained information that would contribute to the National Register Eligibility of the Middleford Mills archaeological district. Furthermore, the results suggest that the middle gates area of the Middleford mills may contain information important to the district as a whole as well. Excavations under the bridge there (Bridge 237) may help show how wide and how deep those gates were originally. They may also show what type of gates were used there, and whether there is evidence of past flood damage.

Excavation further west along the mill dam may show whether there was in fact once an additional race for the planing mill, as suggested by the insurance records. Excavations in the mill races themselves may show how wide the wheels were, which would allow for a refining of the formulae calculating their discharge rates.

There is also likely considerable archaeological potential within other areas of the old mill complex, and the town of Middleford. Further study could illuminate the date and function of other mill-related features identified during the GPS survey, and identify the location of the 18th-century forge. Further PIXE analysis would have the potential to define more about the history of iron making in the area. The old town of Middleford appears not to have been developed extensively since the mills were abandoned. There is therefore a potential for sites associated with the town to be fairly well preserved. All of

these resources together constitute an invaluable asset to the early industrial history of Sussex County.

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Appendix

Chain of Title, Middleford Mills

Year	Owner(s)	Reference
1760s	Joseph Vaughan and Company	Scharf 1888
1802	Heirs of Joseph Pennell	Deed Book AB 25:114-117
1805	William Huffington, Jr., James Huffington, and Thomas Townsend	Deed Book AB 25:114-117
1805	William Huffington, Jr. and James Huffington	Deed Book AB 25:117-118
1807	William Huffington, Jr.	Deed Book AB 25:525-526
1814	William and Edward Huffington.	Orphans Court Case Files 1815
1817	William Huffington	Deed Book AK 33:326
1823	Sussex County sheriff	Deed Book AM 35:564-565
1823	Mitchell Huffington	Deed Book AM 35:564-565
1823	Thomas Townsend	Deed Book AM 35:564-565
1827	Thomas Townsend's heirs	Orphans Court Case Files 1831-1832
1832	Barkley Townsend	Orphans Court Case Files 1831-1832
1832	Robert Houston (half)	Deed Book 45:380-384
1832	William and Michael Stuart (half)	Deed Book 43:313-314
1845	Lot Rawlins (Houston's half)	Deed Book 52:238
1850s?	Lot Rawlins (Stuarts' half)	none
1862	James and John .M. Rawlins	Will Book M12:43-46
1900	Robert Purvis	Deed Book 135:85
1923	Robert Purvis' Heirs	Deed Book 239:548-551; 552-554
1943	H. Rafe Griffith	Deed Book 340:225-228
1945	Various owners	various

Middleford Mills Tax Assessments				
Year	**Owner(s)**	**Description**	**Value**	**Hundred**
1796	Marshall, Wishart & Pennell & Company	Mill lot and stream and dam, 30 acres	£250	Nanticoke
		Forge tract and dwelling house, mill and stream	£700	Nanticoke
1803	Vaughan and Douglass	5000 acres	$7500	Nanticoke
1806	No listing			Nanticoke
1807	William and James Huffington	Sundry store goods	$250	Northwest Fork
1809	William Huffington and others	400 acres	$600	Nanticoke
	William Huffington	5 acres improved in town of Middleford/55 acres	$760/$52	Northwest Fork
1812	No listing			Nanticoke
1816	Heirs of William Huffington, Jr.	430 acres and forge and sawmill	$1290	Nanticoke
		70 acres adjoining Middleford	$420	Northwest Fork
		Mansion house and lot in Middleford	$500	Northwest Fork
		Store house and lot in Middleford	$200	Northwest Fork
		2 houses and lots, rents for $18 each	$100	Northwest Fork
		1 house rents for $60	$200	Northwest Fork
		1 house rents for $12	$50	Northwest Fork
1819	Edward and William Huffington	No description	$840	Nanticoke
1822	Thomas Townsend	470 acres	$940	Nanticoke
	Edward and William Huffington (transfer to Thomas Townsend)	1 house and lot in Middleford	$500	Northwest Fork
		1 house store and counting house rents $24	$150	Northwest Fork
		1 house occupied by Ephraim Collins	$150	Northwest Fork
		6 small houses rents for $12 per year each	$500	Northwest Fork
1825	No listing			Nanticoke
1827	No listing			Nanticoke
	Thomas Townsend's heirs	All property in and about Middleford	$2000	Northwest Fork
1834 (recorded in 1833 book)	same	Lands from land assessment	$2000	Northwest Fork
1836	Robert Houston	100 acres and half sawmill	$250	Nanticoke
		200 acres/half of gristmill	$500/$850	Northwest Fork
	William and Michael Stuart	Half sawmills and 100 acres	$250	Nanticoke
		Half of gristmill	$850	Northwest Fork

Middleford Mills Tax Assessments				
Year	**Owner(s)**	**Description**	**Value**	**Hundred**
		1 house and lot in Middleford	$100	Northwest Fork
	William Stuart	1 store house and granary	$200	Northwest Fork
1840	Robert Houston	100 acres, half sawmill	$250	Nanticoke
	William and Michael Stuart	100 acres	$250	Nanticoke
1841 (recorded in 1840 book)	Robert Houston	200 acres/half mill	$450/$850	Northwest Fork
	William and Michael Stuart	Half mill and 3 houses and lots	$1055	Northwest Fork
1844	Robert Houston	100 acres, half sawmill	$200	Nanticoke
		Half part of Middleford Mill property including houses and lots, transferred to Lot Rawlins	$850	Northwest Fork
	William and Michael Stuart	100 acres, half sawmill	$200	Nanticoke
		1 store house and lot	$200	Northwest Fork
		1 house and lot	$200	Northwest Fork
		1 house and lot	$300	Northwest Fork
		1 house and lot	$20	Northwest Fork
		1 cooper's shop on ground, rent $10, half Middleford Mills property including houses and lots	$850	Northwest Fork
	Lot Rawlins	200 acres/1 house and lot and store house	$200/$500	Northwest Fork
(recorded in 1840 book)	William and Michael Stuart	Store house and lot from William Stuart	$200	Northwest Fork
1846 (recorded in 1844 book)	Lot Rawlins from Robert Houston	Half mill and 100 acres	None given	Nanticoke
1847 (recorded in 1844 book)	Lot Rawlins	Acquired from Robert Houston/deduct for destruction of the mill	$850/-$350	Northwest Fork
1848	Lot Rawlins	1055 acres, half sawmills	$1466	Nanticoke
		200 acres, one house lot and half mills and lots in Middleford	$1200	Northwest Fork
	William and Michael Stuart	4 houses and lots and half mills	$950	Northwest Fork
1852	Lot Rawlins	60 acres and sawmill (also other unrelated lands valued separately)	$1500	Nanticoke
		1 lot with dwelling and store house	$750	Northwest Fork
		4 houses and lots	$125/$100/$50/ $50	Northwest Fork
		2 acres of land, old field near Middleford	$30	Northwest Fork

Middleford Mills Tax Assessments				
Year	**Owner(s)**	**Description**	**Value**	**Hundred**
		1 lot with old burnt gristmill at Middleford, half the stream and 2 old houses thereon	$1000	Northwest Fork
1856	Lot Rawlins	1076 acres	$9560	Nanticoke
		352 acres from land assessment	$2376	Northwest Fork
		Lot with mill and stream	$1500	Northwest Fork
		5 houses and lots	$1075	Northwest Fork
1857	Lot Rawlins	1076 acres	$9560	Nanticoke
1860	Lot Rawlins	1 sawmill and stream and 75 acres (also other lands valued separately)	$1000	Nanticoke
	James and J.M. Rawlins	1 gristmill and carding [machine?] with half the stream at Middleford	$1800	Northwest Fork
1864	J.M. and J. Rawlins	1 sawmill and stream	$1000	Nanticoke
		1 gristmill (each have other lots as well)	$1800	Northwest Fork
1868	John M. and James Rawlins	75 acres and 1 sawmill	$1200	Nanticoke
		2 houses and lots, 1 gristmill, carding and planing mill	$2000	Northwest Fork
		2 houses and lots, 1 gristmill, carding [mesher?] and planing mill	$2000	Seaford
1872	John M. and James Rawlins	1 mill and stream and 75 acres	$1000	Nanticoke
		1 grist, carding, planing mill	$4000	Seaford
1876-80	John M. and James Rawlins	1 mill and stream and 75 acres	$1000	Nanticoke
		1 grist, carding, planing mill	$3000	Seaford
1880-84	John M. and James Rawlins	1 mill and stream and 75 acres	$1200	Nanticoke
		1 mill and factories	$3000	Seaford
1884-88	John M. and James Rawlins	1 mill and stream and 75 acres	$1200	Nanticoke
		1 mill and factories	$3000	Seaford
1888-92	John M. and James Rawlins	1 saw, grist and planing mill/75 acres	$600/$450	Nanticoke
		1 mill property	$3000	Seaford
1892-96	John M. Rawlins	1 water grist and sawmill/75 acres	$500/$450	Nanticoke
	John M. and James Rawlins (transfer to John M. Rawlins heirs)	1 mill property	$3000	Seaford
1896-1900	William H. Rawlins	75 acres	$375	Nanticoke
1901-04	Robert Purvis	Mill property/3 lots and 3 houses	$300/$350	Seaford
1905-08	Robert C. Pervis	60 acres	$300	South Nanticoke
1909-12	Robert C. Pervis	60 acres	$300	South Nanticoke
		1 acre land and mill	$1000	Seaford
1913-16	Robert C. Pervis	25 acres	$200	South Nanticoke
		Mill property/2 lots and houses	$500/$480	Seaford
1916-1920	Robert C. Purvis	114 acres with improvement at Middleford	$1000	

Middleford Mills Tax Assessments				
Year	**Owner(s)**	**Description**	**Value**	**Hundred**
1921	Robert C. Purvis, Estate	114 acres with improvement at Middleford	$1400	
1922	Robert C. Purvis, Estate	114 acres with improvement/added improvement	$1400/$100	
1923-1929	John R. Purvis	1 acre with improvement (mill)	$200	
	Alice P. Hill et al.	113 ½ acres and lot/added improvement	$1500/$100	
1930	John R. Purvis	1 acre with improvement (mill)	$200	
	Alice P. Hill et al.	113 ½ acres with improvement	$2000	
1931-1942	John R. Purvis	1 acre with improvement (mill)/added improvement	$200/$400	
	Alice P. Hill et al.	113 ½ acres with improvement	$2000	
1943-1944	John R. Purvis	1 acre with improvement (mill)/added improvement	$200/$400	
	H. Rafe Griffith	113 ½ acres	$1400	
1945	John R. Purvis	1 acre with improvement (mill)/added improvement	$200/$400	
	H. Rafe Griffith transfers	Charles Hurley, 68 ½ acres		
		Charles Gray Friedel, 4 acres		
		Ira. S. Simpler et ux., 3 acres		
		Walter M. and Helen Mickle, 4 acres		
		William A. Hill et ux., 15 acres		
		Raymond H. Williams et ux., 4 acres		
		15 acres not transferred		

Middleford Mills (land adjacent to former mill pond and races) post-1945 land transfers, by parcel

Parcel Number/Acreage	**Year**	**Grantee**	**Grantor**	**Reference**
394/26 acres	1966	Charles W. and Belva B. Hurley	Charles G. Allen, Jr. and Ruth H. Allen	DB 963:326-327
80/no acreage	?	Charles W. and Belva B. Hurley	Charles G. Allen, Jr. and Ruth H. Allen	No deed found
80.01/9 acres	1966	Charles W. and Belva B. Hurley	Charles G. Allen, Jr. and Ruth H. Allen	DB 963:326-327
	1984	Charles G. Allen, Jr. and Ruth H. Allen	David Mark and Anne S. Allen	DB 1320:153
77/no acreage		Ruth M. Friedel	Richard W. and Gertrude M. Harris	DB 480:349
		Gertrude M. Harris	Michael M. and Patricia P. Harris	WB 200:47; DB 2257:113
78/no acreage		Ruth M. Friedel	Louis H. and Elsie Callaway	DB 512:224; DB 561:557
79/6.5 acres	1954	Charles Gray and Mildred A. Friedel	James E. and Ruth M. Friedel	DB 431:326

Parcel Number/Acreage	**Year**	**Grantee**	**Grantor**	**Reference**
	1966	Ruth M. Friedel	Charles N. and Carolyn G. Jackson	DB 599:141
81/no acreage 82/5.88 acres	1950	Raymond H. and Leona W. Williams	Dorothy W. and Louis C. King	DB 393:428-429
			Robert W. King	WB 214:144
83/15 acres	1949	William A. and Frances D. Hill	Samuel L. and Gloria Mellin	DB 388:53
83/5 acres	1963	William A. and Frances D. Hill	Samuel L. and Gloria Mellin	DB 560:649